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Neogene Paleontology in the northern Dominican Republic

7. The Subclass Ostracoda (Arthropoda: Crustacea)

by

W. A. van den Bold

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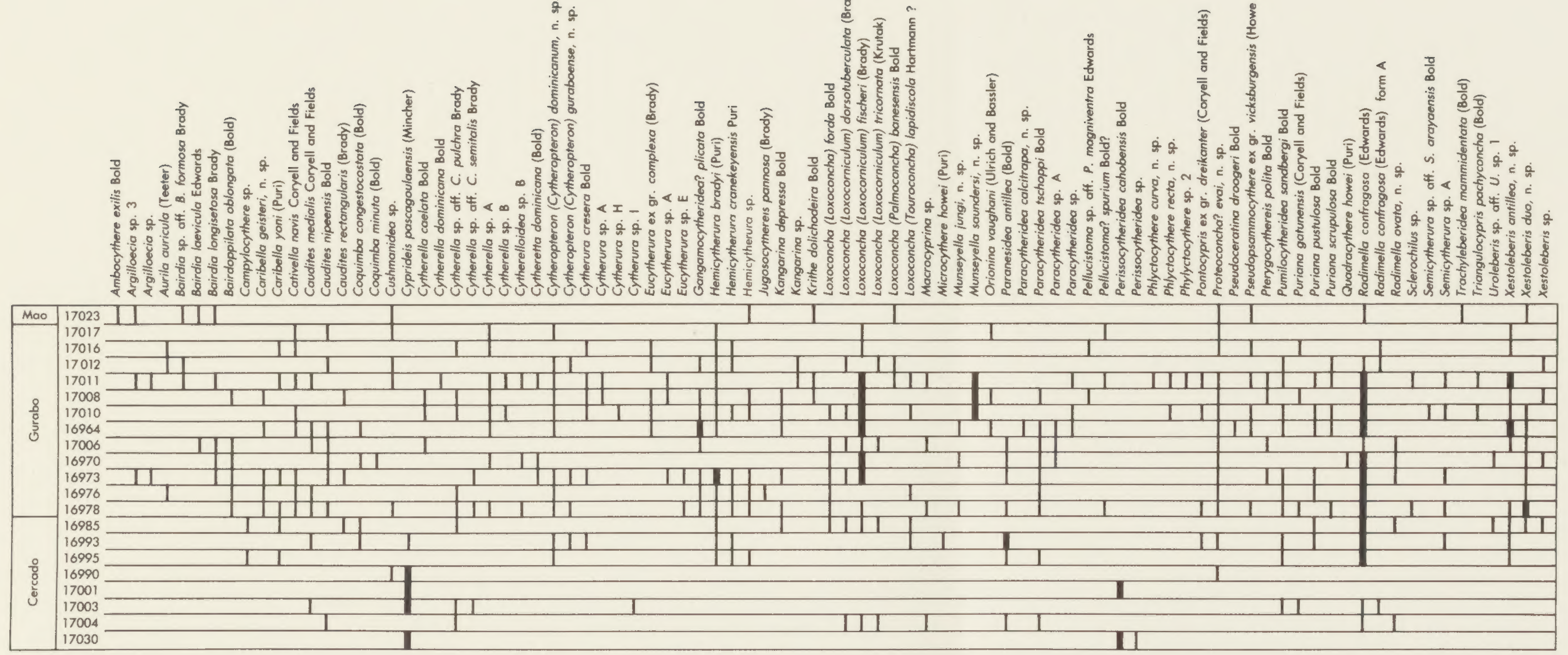

Table 1

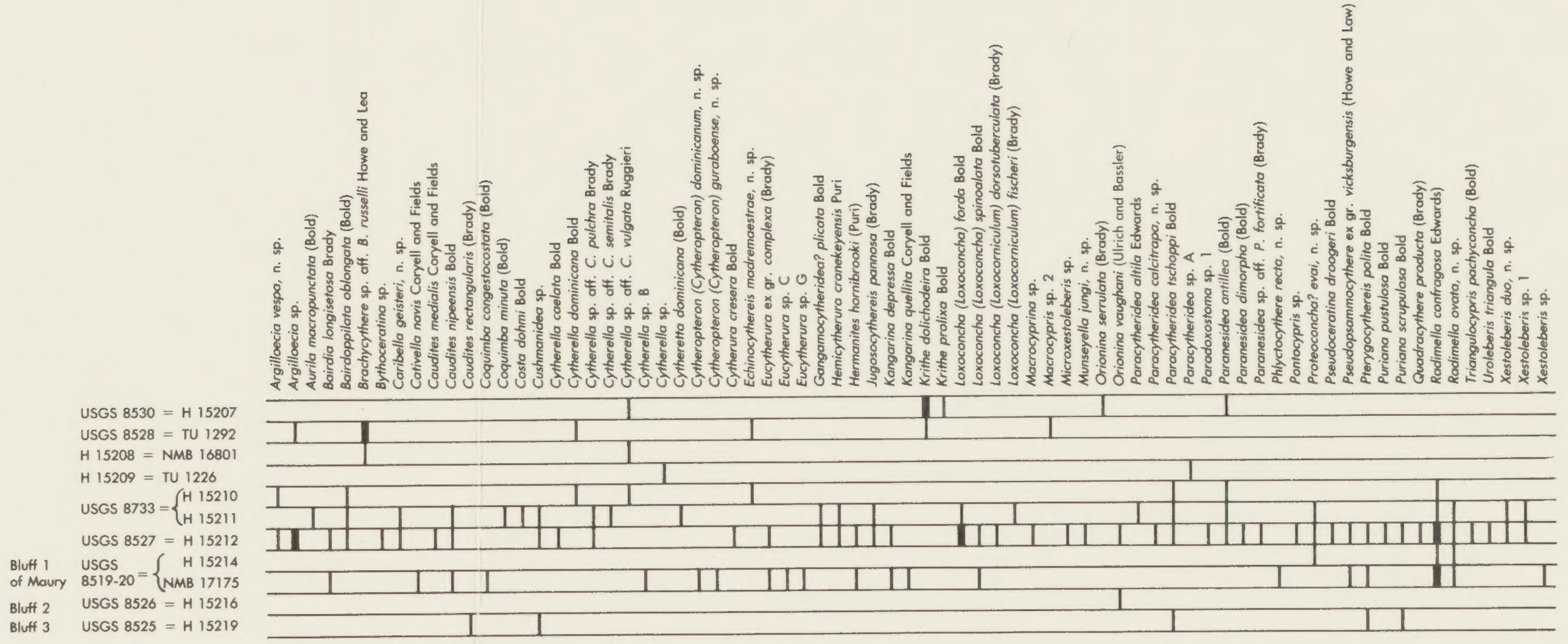

Table 3

Table 1.—Distribution of Ostracoda in samples from the Río Cana section. Narrower line = less than 10 specimens; wider line = 10 or more specimens.

Table 3.—Distribution of Ostracoda in samples from the Río Mao section. Samples with prefix H were collected by Dohm (Dominican Seaboard Oil Company) and were previously used in Bermúdez (1949) and Bold (1968). Samples with prefix TU were collected by Emily and Harold Vokes of Tulane University, New Orleans, LA. The relation to U. S. Geological Survey localities is indicated. ? = occurrence of the species at this locality is questioned.

Table 4.—Distribution of Ostracoda in samples from the Río Yaque del Norte section. The Arroyo López section in this table and in the text reaches from just upstream of the confluence of the Arroyo López and the Río Yaque del Norte (Saunders, Jung, and Biju-Duval, 1986, text-fig. 26) to the upstream portion of the Angostura Gorge (Saunders, Jung, and Biju-Duval, 1986, text-fig. 27), a thickness of about 200 m. ? = specimens cannot be identified with certainty.

Table 5.—Comparison of ostracode faunas from the Laguana and Bayaguana amber sites with the fauna of the Anguilla Formation (Lesser Antilles) and with the known stratigraphic range of the species. Arrows indicate that the range of the species extends beyond the interval shown. ? = range of the indicated species, compared to the planktonic foraminiferal zonation, is uncertain.

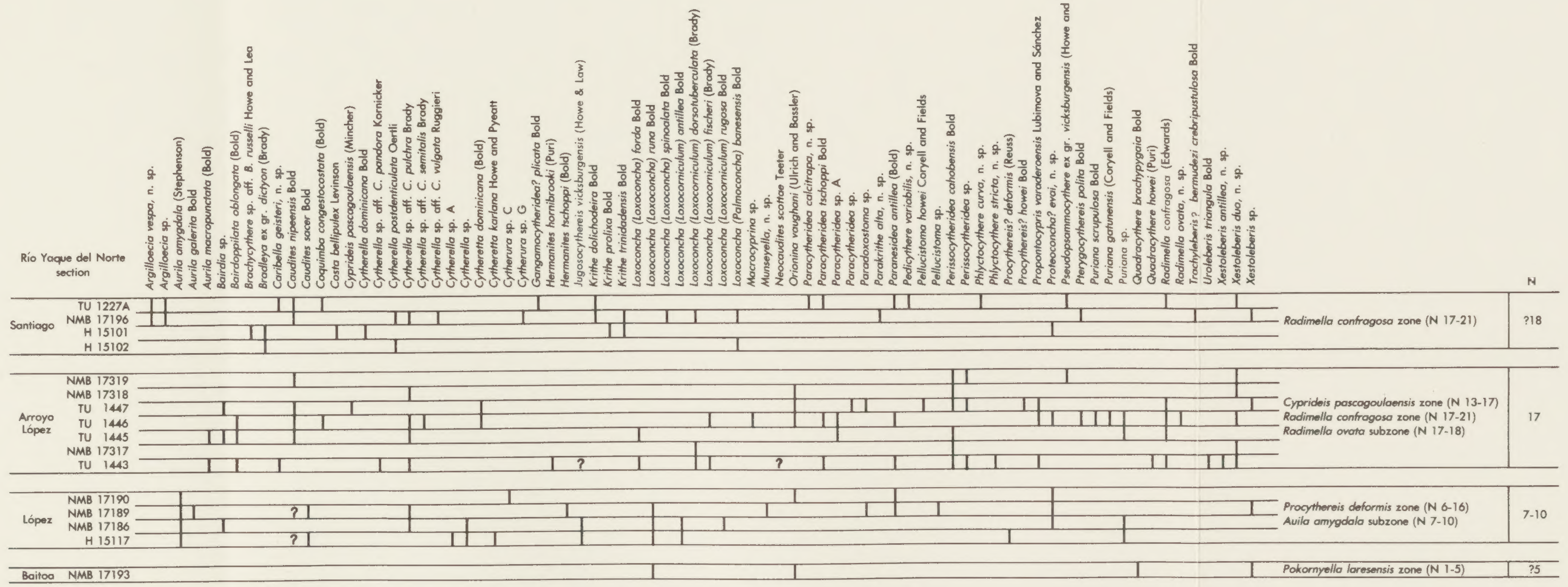

Table 4

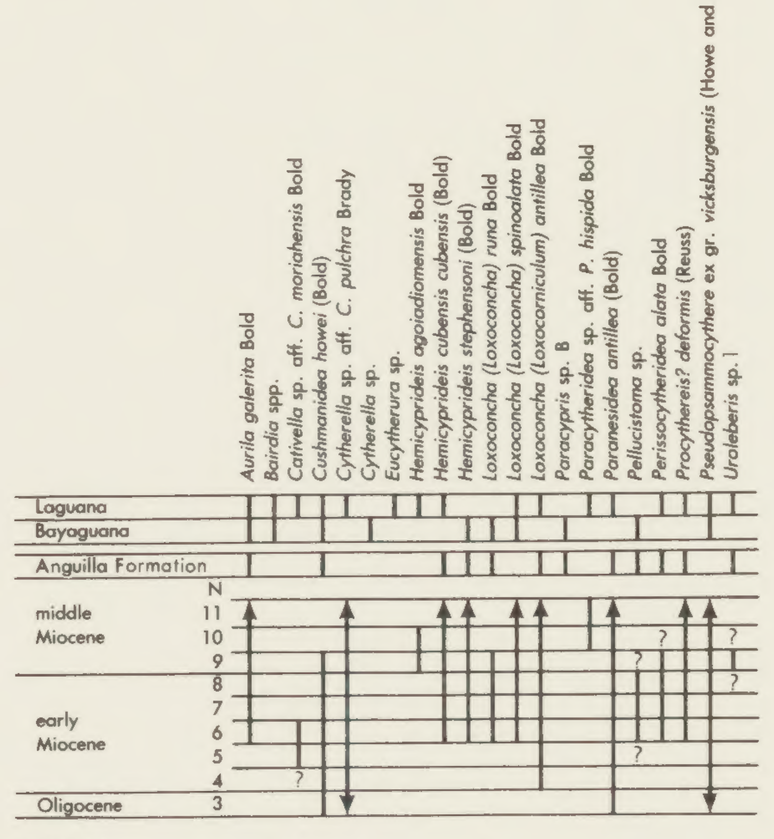

Table 5

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NOTE

The type and figured specimens illustrating the majority of fossil groups described from the Dominican Republic Project will be deposited at the Naturhistorisches Museum Basel (Basel, SWITZERLAND). In the case of the Ostracoda, however, a large proportion of type material from the Caribbean area has for many years been deposited in the H. V. Howe collection at Louisiana State University (Baton Rouge, LA, U.S.A.). For this reason, all figured specimens from this paper, including the holotypes and figured paratypes will be deposited in the H. V. Howe collection at Baton Rouge. Unfigured paratypes of new species will be deposited in the Naturhistorisches Museum Basel collections, together with a complete set of ostracodes used in the study, as identified by the author.

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NEOGENE PALEONTOLOGY IN THE NORTHERN DOMINICAN REPUBLIC

7. The Subclass Ostracoda (Arthropoda: Crustacea)

By

W. A. van den Bold

Department of Geology
Louisiana State University
Baton Rouge, LA 70803, U.S.A.

ABSTRACT

One hundred and forty-five species are reported from the Cercado, Gurabo and Mao formations of the Río Gurabo, and Rio Cana sections on the south flank of the Cibao Valley, northern Dominican Republic. Twenty-one species are new: *Argilloecia vespa, Bythoceratina monoceros, Caribella geisteri, Cytheropteron* (*Aversovalva*) *bijuduvali, Cytheropteron* (*Cytheropteron*) *dominicanum, Cytheropteron* (*Cytheropteron*) *guraboense, Echinocythereis madremaestrae, Eucytherura fithianae, Munseyella jungi, Munseyella saundersi, Paracytheridea calcitrapa, Parakrithe alta, Pedicythere variabilis, Phlyctocythere curva, Phlyctocythere recta, Phlyctocythere stricta, Proteoconcha*? *evai, Pterygocythereis llinasi, Radimella ovata, Xestoleberis antillea* and *Xestoleberis duo.* The uppermost Cercado Formation and the Gurabo and Mao formations belong to the *Radimella confragosa* Zone (upper Miocene–Pliocene). Below the Cercado Formation the lower part of this zone coincides with the upper part of the brackish-water *Cyprideis pascagoulaensis* Zone (middle to upper Miocene). The two sections show increasing depth of deposition with decreasing age, the Río Cana section remaining considerably shallower than the Río Gurabo section. Beds, equivalent to the Gurabo Formation in the Río Yaque del Norte section near Santiago were deposited at greater depth than those of the Río Mao, Río Gurabo and Río Cana sections farther west. Underlying beds in the Río Yaque section (Arroyo López) carry a fauna similar to that of the upper Cercado Formation. The lower part of the Río Yaque section (López and Baitoa) has a fauna that is similar to that of the amber sites on the south flank of the Cordillera Central and to that of the Anguilla Formation of the Lesser Antilles, which are believed to be of similar age (close to the early–middle Miocene boundary).

RESUMEN

Ciento cuarenta y cinco especies son citadas de las formaciones Cercado, Gurabo y Mao en las secciones de los Rios Gurabo y Cana al pendiente Sur del Valle de Cibao, República Dominicana septentrional. Veinte y una especies son nuevas: *Argilloecia vespa, Bythoceratina monoceros, Caribella geisteri, Cytheropteron* (*Aversovalva*) *bijuduvali, Cytheropteron* (*Cytheropteron*) *dominicanum, Cytheropteron* (*Cytheropteron*) *guraboense, Echinocythereis madremaestrae, Eucytherura fithianae, Munseyella jungi, Munseyella saundersi, Paracytheridea calcitrapa, Parakrithe alta, Pedicythere variabilis, Phlyctocythere curva, Phlyctocythere recta, Phlyctocythere stricta, Proteoconcha*? *evai, Pterygocythereis llinasi, Radimella ovata, Xestoleberis antillea* y *Xestoleberis duo.* La parte superior de la formación Cercado y las formaciones Gurabo y Mao pertenecen a la zona de *Radimella confragosa* (Mioceno superior y Plioceno). Dentro de la formación Cercado la parte inferior de esta zona coincide con la parte superior de la zona de *Cyprideis pascagoulaensis* (Mioceno medio–superior) de la zonación del ambiente agua salobre. Ambas secciones muestran una aumentación de profundidad de deposición en estratos más jovenes, la sección del Río Cana quedando siempre menos profundo que la sección del Río Gurabo. Lechos de la sección Río Yaque del Norte cerca de Santiago, contemporaneos con la formación Gurabo, fueron depositados en profundidades mayores que en las secciones de los Ríos Mao, Gurabo y Cana, que estan mas al oeste. Estratos debajo de las mencionados arriba en la sección del Río Yaque del Norte (Arroyo López) tienen una fauna comparable con la fauna de la formación Cercado. La porción inferior de la sección del Río Yaque del Norte tiene una fauna comparable con las faunas de los sitios de ámbar en el pendiente sur de la Cordillera Central y con estas de la formación Anguilla de las Antillas Menores, cuales son probablemente de una edad similar, cerca del limite Mioceno inferior–medio.

INTRODUCTION

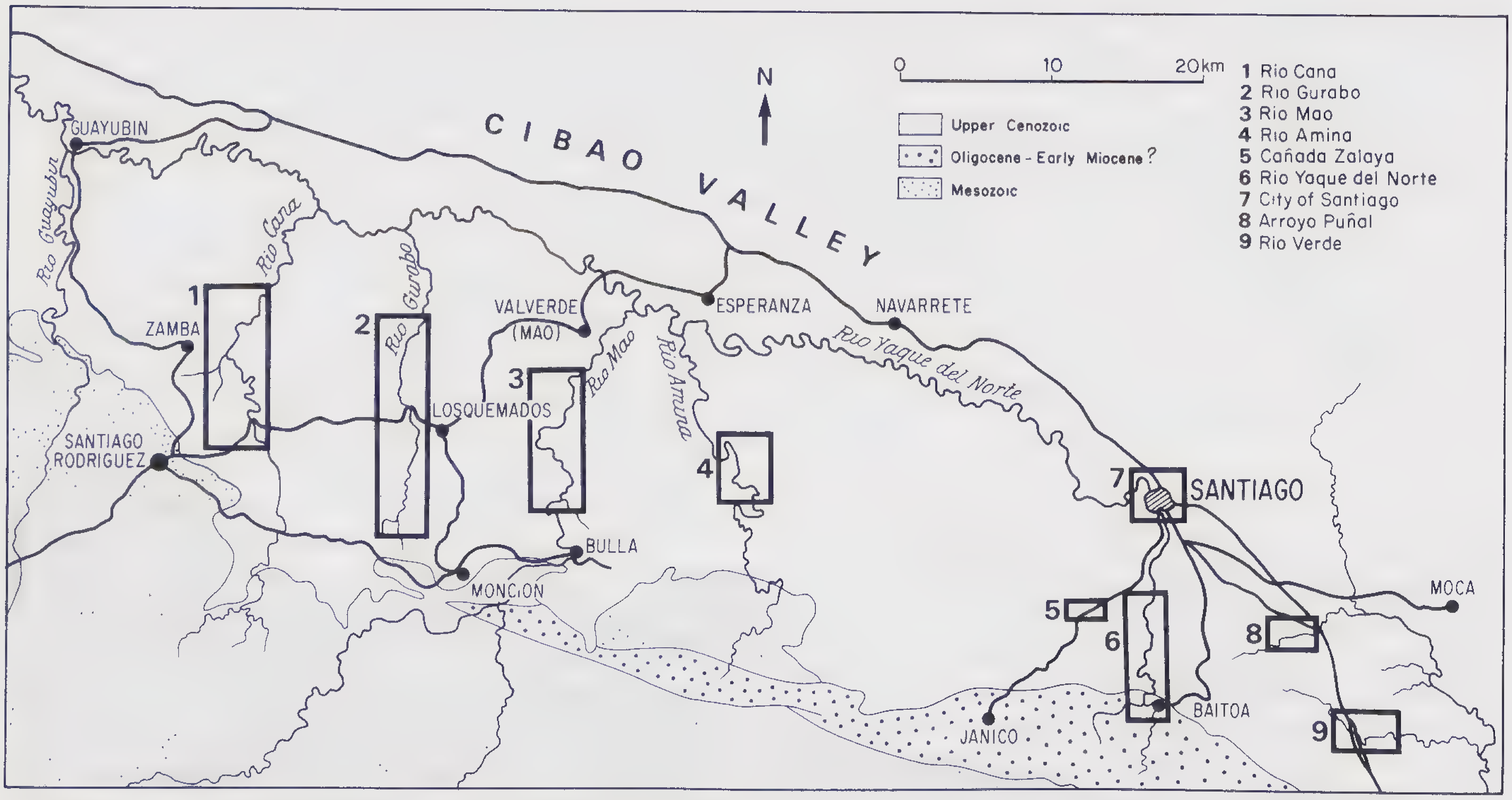
In January, 1978 and March, 1979, the author joined the Natural History Museum [Basel, Switzerland] expedition to the Cibao Valley, Dominican Republic. While other members of the expedition collected samples for macrofossils (Peter Jung, Tony Eva and Jörn Geister), or described the lithology (Bernard Biju-Duval), or measured sections and plotted sample locations (Christian Meynot and Albert Chartier), John Saunders and I collected samples for microfossils. After the samples had been processed in Switzerland, I went to Basel in the summer of 1980 to collect the ostracodes from the washed residues. As there was only limited time it was impossible to study all samples in detail. Therefore, I briefly examined all samples, and picked the ostracodes from the more promising ones. The picked material was studied in Baton Rouge. Additional material from areas that were not visited by the author were sent later by John Saunders. Supplementary material was received from Emily Vokes, Tulane University, New Orleans, LA.

Prior to 1968, nothing was known about ostracodes in the Dominican Republic, apart from a few scattered remarks (*e.g.*, Bold, 1966a, p. 7). Although the first detailed study (Bold, 1968) represented a big step forward, it unfortunately also contained some misinformation, caused mainly by too much reliance on reported ages, correlations and thicknesses of the formations. This led to an overestimation of the age of the Cercado Formation, and the assumption of an unconformable relationship between the Cercado and Gurabo formations. Furthermore, sample coverage was inadequate, which resulted in a partly erroneous distribution pattern. At that time (1968), I had only three samples in the Río Cana (now 21) and 10 in the Río Gurabo (now 49); only 22 species were reported from the Río Cana section (now 88) and 44 from the Río Gurabo section (now 140). In some cases (*e.g.*, Tables 3 and 4) the "old" samples have been used in the present study. They have the prefix "H" as cited in Bermúdez (1949, pp. 37–46): this prefix was dropped when the samples were later cited by Bold (1968, pp. 11–18).

The new material from the Río Cana and Río Gurabo sections (Text-fig. 1, sects. 1, 2) consists of more than 5000 specimens; the 145 species are treated systematically and the majority are illustrated. Their distribution is shown on Tables 1 and 2. As only one sample was studied from Bluff 1 of Maury (1917) on the Río Mao, previously-collected material (Dominican Seaboard, see Bold, 1968, pp. 10–18) was restudied, and one sample collected by Harold and Emily Vokes (loc. TU 1292) was added to give some idea of ostracode distribution in this section (Text-fig. 1, sect. 3; Table 3). Species found in the Río Yaque del Norte section (Text-fig. 1, sects. 6, 7) are reported in Table 4. Species occurring only in the Río Yaque section (López and Baitoa) are included in the systematics section, as are those reported from the Laguana and Bayaguana amber sites, but are not figured. These species have been described previously from the Madame Joie and Thomonde formations in Haiti (Bold, 1981) or from the Anguilla Formation in the Lesser Antilles (Bold, 1970b). For the position of the samples mentioned and for lithological descriptions the reader is referred to Saunders, Jung, and Biju-Duval (1986). However, the stratigraphic position of locations of the samples in the Río Cana and Río Gurabo has been plotted in Text-figure 5, and the same stratigraphic sequence of samples has been used in the distribution charts (Tables 1 and 2).

ACKNOWLEDGMENTS

Peter Jung and John Saunders invited me to join their expedition to the Cibao Valley, paid my field expenses and were, with the other members of the expedition, part of a very memorable experience. Moreover, they were gracious hosts during my stay at the Museum of Natural History in Basel. Emily and



Text-figure 1.—Location of sections on the south flank of the Cibao Valley, northern Dominican Republic (from Saunders, Jung, and Biju-Duval, 1986, text-fig. 3). Sections 4, 5, 8 and 9 are not treated in this report.

Harold Vokes kindly donated sample material that they collected in the same general area.

Tom Cronin (United States Geological Survey, Reston, VA) and Paul Steineck (State University of New York at Purchase, NY) reviewed the manuscript, which has benefited considerably from their comments.

Woodson Godfrey (Shell Development Company, New Orleans, LA) and Ezat Heydari (Department of Geology, Louisiana State University, Baton Rouge, LA) prepared the electron micrographs and Dan Peace (departmental photographer, Department of Geology, Louisiana State University, Baton Rouge, LA) did the printing. The secretarial staff of the LSU Department of Geology typed the final manuscript.

BIOSTRATIGRAPHY

Río Gurabo and Río Cana sections
(Text-fig. 1 [sects. 1, 2, 3]; Tables 1, 2)

The biostratigraphic zonation of the Caribbean post-Eocene, based on Ostracoda (Bold, 1983), is slightly emended in Text-figure 2 by the addition of the *Radimella ovata* Taxon Range Zone, and the substitution of *Pokornyella poagi,* as a new name for *Pokornyella saginata* (Stephenson) *sensu* Poag, 1974 (p. 59, pl. 6, figs. 6–8; not *Hemicythere saginata* Stephenson, 1944, p. 158, pl. 28, figs. 16, 17) in the *Pokornyella* "*saginata*" / *Pokornyella laresensis* Taxon Range Zone of Bold (1983).

The Cercado Formation lies within the *Cyprideis pascagoulaensis* Taxon Range Zone of the Caribbean brackish water zonation (Bold, 1976), middle to late Miocene (planktonic foraminiferal zones N 13–17 of Blow, 1969). The upper part of this zone overlaps with the *Radimella confragosa* Partial Range Zone (Bold, 1983), now recognized as of late Miocene and Pliocene age (N 17–21), which zone occurs in the upper part of the Cercado Formation and the Gurabo and Mao formations. The first occurrence of *Radimella* Pokorný, 1969, called the *Radimella* event (Bold, 1983), occurs in the Río Cana section (see Table 1 and Text-fig. 4) at 165 m above the base of the Cercado Formation and in the Río Gurabo section at 175 m above the base. This event has been recognized throughout the Caribbean (Text-fig. 3), from Central America through South America and the Greater Antilles to eastern North America as summarized below:

In Costa Rica, the *Radimella* event has been recognized in the lower part of the Río Banano Formation (Limón Basin), about 300 m above the top of the Uscari Formation (N 17), where first shallowing of the environment takes place (Bold, 1978b, table 9). *Radimella ovata,* n. sp., was found in the upper part of the Venado Formation (Sen Gupta, Malavassi, and Malavassi, 1986, p. 219).

In Colombia, this event occurs in the Lower Magdalena River valley, in the lower part of the Tubará Formation (Bold, 1966e), and also at the base of the Chorrera Formation.

In Venezuela, the *Radimella* event has been recognized in three areas: in the lower part of the Punta Gavilán Formation in Falcón (Bold, 1973b), where it corresponds to N 17, *Globorotalia dutertrei* s. l. Zone (see Bolli, 1970, fig. 21). Bold (1972a) recognized the event in the El Veral Formation in Falcón, where it also corresponds to N 17 (Blow, 1969). In the Araya peninsula in the State of Sucre, it occurs near the base of the Cerro Verde Member of the Cubagua Formation = *Globorotalia dutertrei* s. l. Zone (Bolli, 1970, fig. 22).

In Trinidad, the earliest *Radimella* is found in the Sabaneta glauconitic clay member of the Springvale Formation (Bold, 1963b), questionably corresponding to N 18 and also in the Biche coreholes (?N 17). This is below the latest occurrence of *Cyprideis pascagoulaensis* (Mincher, 1941).

In Puerto Rico, the base of the *Radimella confragosa* Zone is found in the lower part of the Ponce Formation (Bold, 1969), and in the Lajas beds (Bold, 1975d). Here also the *Cyprideis pascagoulaensis* Zone overlaps with the *Radimella confragosa* Zone.

In Jamaica, the *Radimella* event has been recognized within the Lower Coastal Group (Bold, 1971b), within N 17, and just below the occurrence of *Globorotalia margaritae* Bolli and Bermúdez, 1965 (N 18) [see Text-fig. 3], both in the Buff Bay and San San Bay sections.

In the Dominican Republic, in the Azua Basin, *Radimella* occurs near the top of the Fondo Negro section (Mascle *et al.,* 1980, p. 108, stop 3), with *Cyprideis pascagoulaensis* in juxtaposition. The relationship with the planktonic-foraminiferal zonation is being studied. Similar occurrences have been found in the Arroyo Molinillo and in well El Mogote #1 (Bold, 1983). In the Enriquillo Basin, scattered occurrences of *Radimella* are found in the Las Salinas Formation; therefore no true stratigraphic level for the base of the genus can be recognized here (Bold, 1975a). However the earliest *Radimella* occurs below the last *Cyprideis pascagoulaensis* (Text-fig. 4). In Maury's Bluff 1 (Cibao Valley, Río Mao section), *Radimella* has been found within calcareous nannofossil zone NN 11, late Miocene (Saunders, written commun., 1985).

In Haiti, in the Cul-de-Sac Basin, *Radimella* occurs in the uppermost Rivière Grise Formation (Bold, 1975a). The last *C. pascagoulaensis* has been found in the directly-overlying Morne Delmas Formation (Text-fig. 4). In the St. Marc area the *Radimella* event has been recognized in the uppermost "Thomonde" Formation (Bold, 1981), close to N 17–18 contact (Text-fig. 4).

Epoch		Zones of planktonic foraminifera		Ostracode zone: Shallow marine		Ostracode zone: Brackish water
Pleistocene		22/23	*Gr. truncatulinoides*	*Radimella wantlandi*		*Cyprideis salebrosa*
Pliocene		20/21	*Gr. tosaensis*	*Radimella confragosa*		
		19	*Gr. miocenica*			
			Gr. margaritae			*Cyprideis subquadraregularis*
		18			*Radimella ovata*	
Miocene	Late	16/17	*Gr. humerosa*	*Coquimba congestocostata*		*Cyprideis pascagoulaensis* — *C. subquadraregularis*
			Gr. acostaensis	*Procythereis? deformis*		*Cyprideis pascagoulaensis*
	Middle	15	*Gr. menardii*		*Hermanites hutchisoni*	
		14	*Gr. mayeri*			
		12/13	*Gr. robusta / Gs. ruber*			*Cyprideis aff. ovata* — *C. pascagoulaensis*
		11	*Gr. lobata*			
		10	*Gr. fohsi*		*Aurila amygdala*	
		9	*Gr. peripheroronda*			*Cyprideis aff. ovata.*
	Early	8	*Po. glomerosa*			
		7	*Ga. insueta*			
		6	*C. stainforthi*		*Triebelina crumena*	
		5	*C. dissimilis*	*Pokornyella poagi* — *P. laresensis*		
		4	*Gs. primordius*		*Hermanites tschoppi*	
Oligocene		3	*Gr. kugleri*		*Triebelina howei*	
			G. ciperoensis			
		2	*Gr. opima*		*Lococoncha (Loxocorniculum) lienenklausi*	
		1	*G. ampliapertura*			
		18/19	*Ca. chipolensis / Ps. micra*			

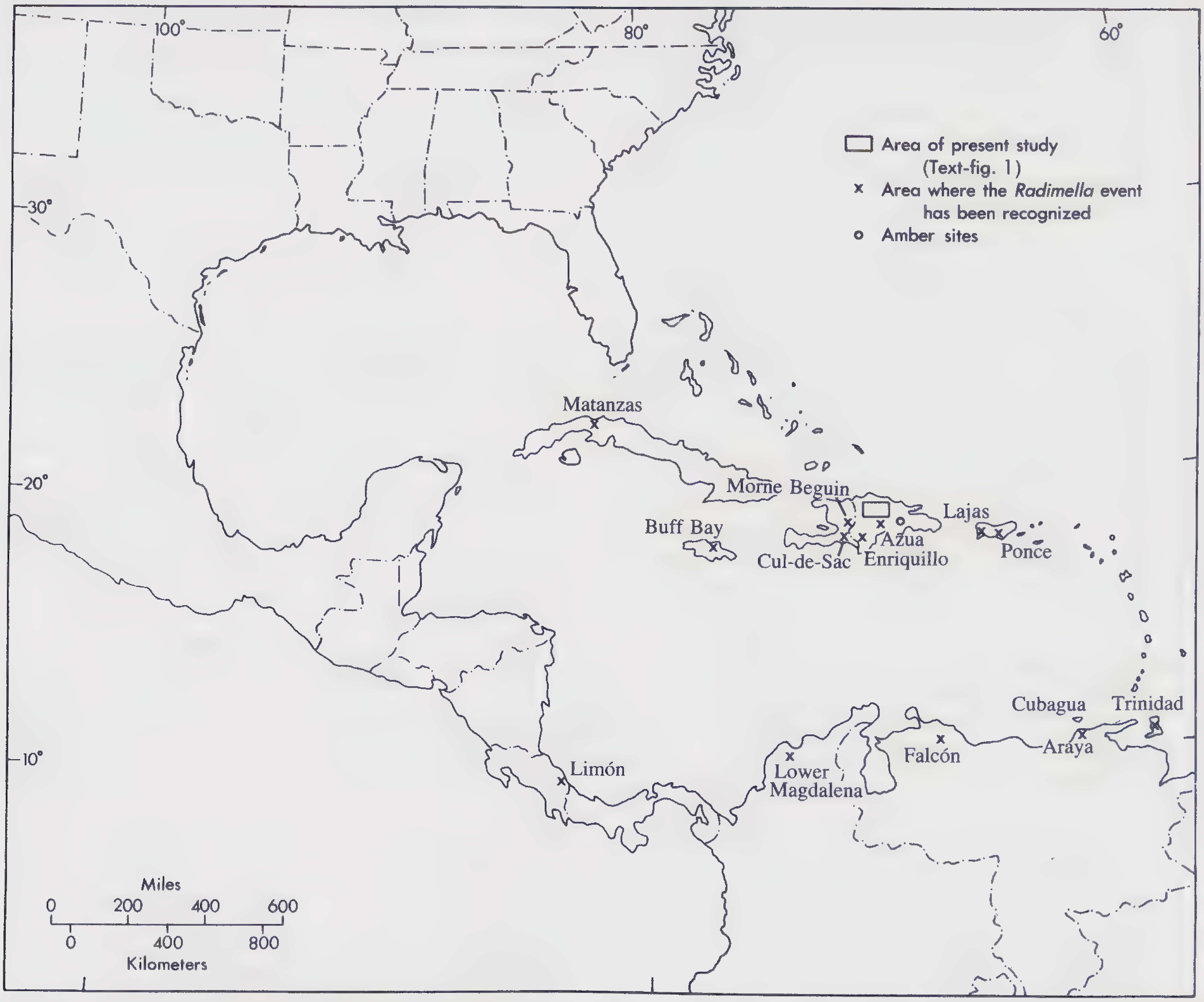
Scale bar: 1 million years

← Text-figure 2.—Ostracode zonation of the post-Eocene part of the Caribbean Cenozoic (emended from Bold, 1983, fig. 6). Note that the base of the *Radimella confragosa* PRZ is placed in the upper part of the upper Miocene, and that the new *Radimella ovata* TRZ extends from the first occurrence of *Radimella* to within the lower part of the Pliocene. Description and discussion of the other zones, and the ranges of the more important species can be found in Bold (1983, pp. 407–411, text-figs. 1–4, 7). TRZ = Taxon Range Zone, observed stratigraphic range of the species in question. PRZ = Partial Range Zone, that part of the range of the nominate species that is characterized by co-occurrence of other taxa (Assemblage Zone) or by the absence of certain other taxa (Interval Zone). They are correlated, where possible, with planktonic foraminiferal zones. The latter are indicated by N (1–23) or P (18/19) numbers of Blow, 1969, and by the species name of the zones of Bolli and Saunders (1985). Planktonic foraminiferal generic names are abbreviated as follows: *C.* = *Catapsydrax*; *Ca.* = *Cassigerinella*; *G.* = *Globigerina*; *Ga.* = *Globigerinatella*; *Gr.* = *Globorotalia*; *Gs.* = *Globigerinoides*; *Pa.* = *Praeorbulina*; *Ps.* = *Pseudohastigerina*.

In Cuba, in Matanzas Province, the earliest *Radimella* occurs in the Capas de *Gypsina* (Bold, 1975c).

In eastern North America, *Radimella confragosa* (Edwards, 1944), has been reported in the *Ecphora* biofacies of the Choctawhatchee Stage in Florida (Puri, 1954) and the upper part of the Yorktown Formation of North Carolina and Virginia (Hazel, 1977). The species was originally described from the Duplin marl of North Carolina (Edwards, 1944).

The accumulated evidence places the *Radimella* event within zone N 17 of the planktonic-foraminiferal zonation and within zone NN 11 of the nannofossil zonation (= late Miocene). It appears that the final extinction of *C. pascagoulaenis* takes place at or just below the Mio-Pliocene boundary. Another species of *Radimella* (*Radimella ovata*, n. sp.) appears to be of greater regional importance than originally thought.

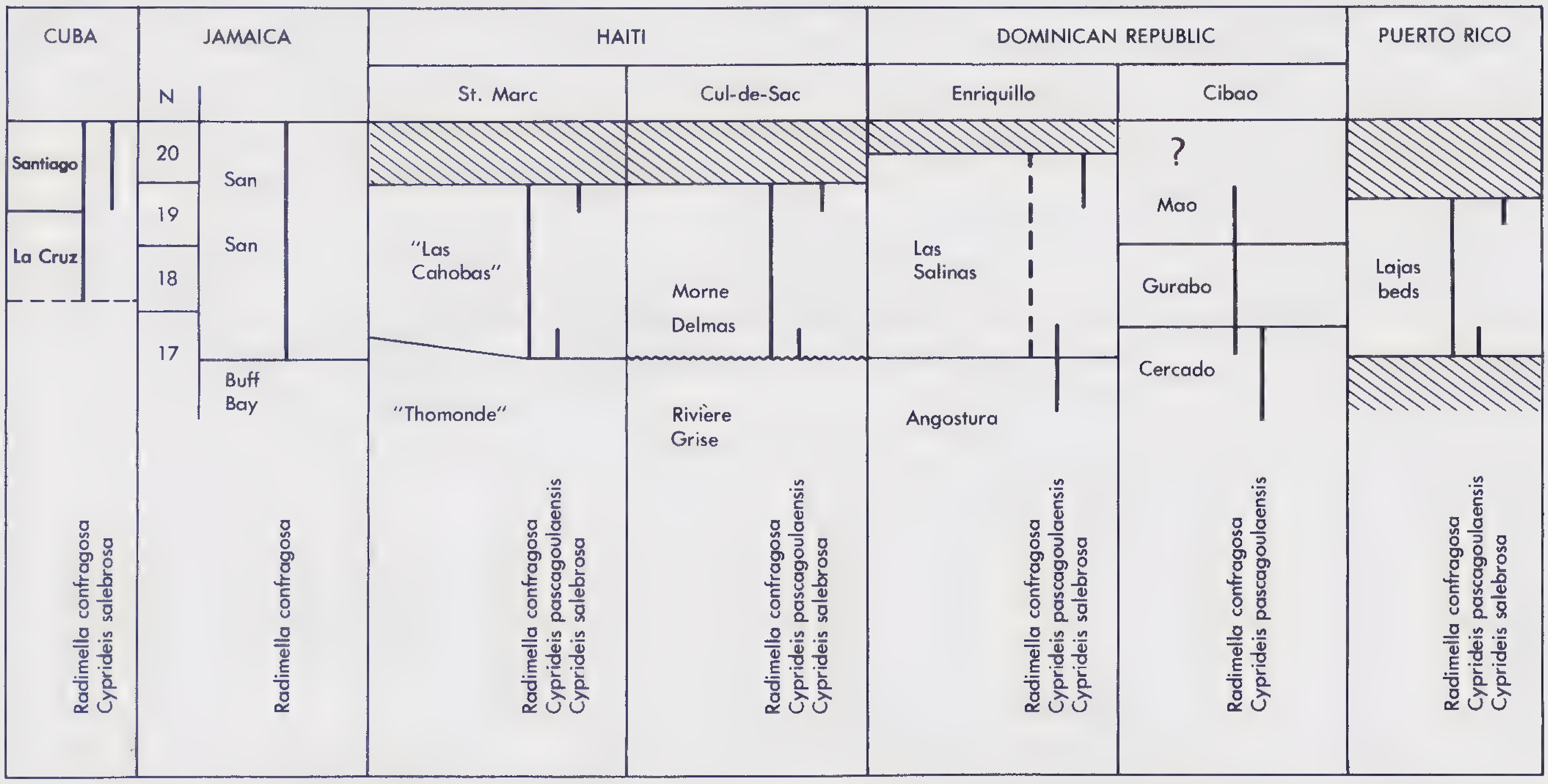


Text-figure 3.—Location map of the Caribbean, indicating the present study area, the areas where the *Radimella* event has been recognized, and the location of the Laguana and Bayaguana amber sites.

This species disappears in the Río Gurabo section at about the Mio-Pliocene boundary (level 400 m), and in the Río Cana section at 380 m (Text-fig. 5), in the part of the section questionably identified as calcareous nannozone NN 12, about 50 m below the base of nannozones NN 13–14 (Saunders, Jung, and Biju-Duval, 1986). It seems possible that its disappearance in the Río Gurabo section may occur before the extinction of the species and may be caused by deepening of the environment. Also *Radimella confragosa* and *R. confragosa* form A of Bold, 1975b, become scarce above the 400 m level. *Coquimba congestocostata* (Bold, 1963b) disappears in the Río Cana section before the disappearance of *R. ovata,* but in the Río Gurabo section it persists for a short distance above this level of disappearance. The disappearance of *Radimella ovata* was previously noted in Costa Rica in the lower part of the Río Banano Formation, in Venezuela at the top of the Cerro Macho Member of the Cubagua Formation (N 18), and in Trinidad in the Sabaneta glauconitic clay member of the Springvale Formation (Bold, 1975b). Therefore the total range of this species appears to be from within N 17 to within N 18.

Bold (1975a, p. 181) suggested that the occurrence of *Uroleberis torquata* Bold, 1968, might be of stratigraphic significance in the Greater Antilles. In the Dominican Republic this species has been found in the Mao Formation of the Río Gurabo section (level 710 m), and equivalent beds on the old Santiago–Puerto Plata road (Bold, 1968, text-fig. 6, table 11); also in the Jimaní Formation of the Enriquillo Basin (Bold, 1975a, table 4, text-fig. 7).

In Haiti the species occurs at the top of the Morne Beguin section (Bold, 1981, pp. 56, 107) and in Cuba in the La Cruz Formation near Santiago de Cuba (Bold, 1975c, table 4, text-fig. 4). The first occurrence of this species lies well above the extinction levels of *Cyprideis pascagoulaensis* and *Radimella ovata,* but below the level of appearance of *Cyprideis salebrosa* Bold, 1963b (late Pliocene). In the Pleistocene of the Matanzas Formation in Cuba and the Navy Island and Manchioneal formations in Jamaica it is replaced by what appears to be its immediate descendant, *Uroleberis angulata* (Brady, 1870a), which species is living on the Bahamas platform and among reefs off the coast of Nicaragua. *U. torquata* Bold, 1968 is probably indicative of late Pliocene (to possibly earliest Pleistocene) age; however, it has not been possible to tie its presence to the standard planktonic-foraminiferal zonation, because it, like *U. angulata,* appears to be restricted to shallow water,



Text-figure 4.—Distribution of *Radimella confragosa* (Edwards, 1944), *Cyprideis pascagoulaensis* (Mincher, 1941) and *Cyprideis salebrosa* Bold, 1963b in the upper Miocene and Pliocene of the Greater Antilles. No vertical scale is attempted as no direct correlation with planktonic foraminiferal zones is possible.

The upper part of the section between the City of Santiago de Cuba and Loma Quintero was named the Santiago Formation by Franco, 1976 (type locality: loc. CU 30 of Bold, 1975c), and separated from the La Cruz Formation (Jakus, 1983, p. 77).

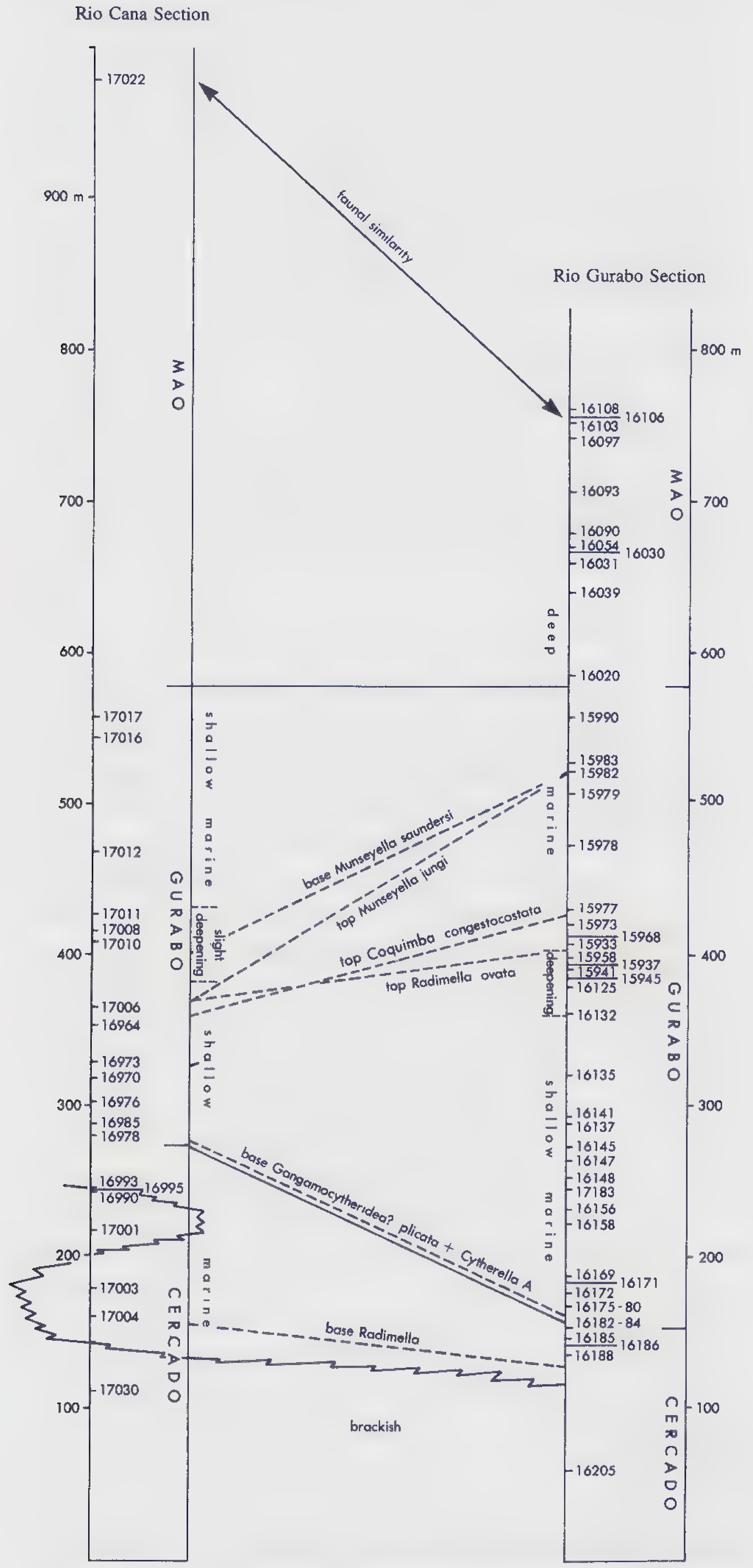
The names of Thomonde and Las Cahobas formations have been used in the St. Marc area of Haiti, but are placed here in quotation marks as they represent younger strata than those in the type areas of these formations (Bold, 1981).

Occurrence of *Radimella* is discontinuous in the Las Salinas Formation of the Enriquillo Basin, Dominican Republic (Bold, 1975a). The upper part of the Mao Formation was not studied.

highly calcareous environments where planktonic foraminifera are scarce.

RÍO MAO SECTION
(Text-fig. 1 [sect. 3]; Table 3)

As only one new sample was received from the Río Mao section (loc. NMB 17175, Bluff 1 of Maury), old



Text-figure 5.—Correlation between the Río Cana and Río Gurabo sections on the basis of first occurrence (base) and last occurrences (top) of ostracode species (dashed lines) and formational boundaries (solid lines). The change in facies from brackish water to shallow marine is indicated by a zig-zag line.

Dominican Seaboard material (Bold, 1968) was restudied to get at least some idea of the ostracode distribution and to enable some comparison with the other sections (samples with prefix "H"). Material from loc. TU 1292 was also examined. The result is stratigraphically not very significant (only 11 samples); however, a few facts emerge:

1. The first occurrence of *Radimella confragosa* in Maury's Bluff 1 falls within nannofossil zone NN 11 (upper Miocene).
2. *Radimella ovata* persists until loc. USGS 8733 and does not occur higher in the section (compare this occurrence to its position in the Río Gurabo section).

RÍO YAQUE DEL NORTE SECTION
(Text-fig. 1 [sects. 6, 7]; Table 4)

Only eight samples from the Río Yaque del Norte section contained ostracodes. Therefore they were combined with previously-collected samples (prefix "H") of the Dominican Seaboard Oil Company (Bold, 1968) and some (prefix "TU") collected by Emily and Harold Vokes (Tulane University). It was in this section that a serious mistake was made by Bold (1968). Dominican Seaboard geologists mapped this area and their results were, in part, published by Bermúdez (1949). Bermúdez included their Baitoa Formation (lowermost part of the section) in the Cercado Formation. Following this example Bold (1968) suggested a partly middle Miocene age for the Cercado Formation.

However, the Baitoa Formation contains *Quadracythere brachypygaia* Bold, 1965b, and *Loxoconcha runa* Bold, 1970b, and their combined range (N 3–6 and N 5–9 respectively) [Bold, 1983] suggests an early Miocene age (N 5–6). In a slide labeled "A. A. Olsson, Type Baitoa" (Paleontological Research Institution, Ithaca, NY) *Procythereis*? *deformis* (Reuss, 1850) and *Cytheretta karlana* Howe and Pyeatt *in* Howe *et al.*, 1935, occur.

The unconformably-overlying López section (see Saunders, Jung, and Biju-Duval, 1986, text-fig. 25) shows co-occurrence of *Procythereis*? *deformis, Aurila galerita* Bold, 1965b, *Aurila amygdala* Stephenson, 1944, *Loxoconcha runa, Hermanites tschoppi* (Bold, 1946), and *Caudites sacer* Bold, 1970b, an assemblage typical for the *Aurila amygdala* Subzone of the *Procythereis*? *deformis* Taxon Range Zone (Bold, 1983), suggesting a late early Miocene (N 7) to early middle Miocene (N 10) age. The presence of *Caudites nipeensis* Bold, 1946, which so far had not been found in beds earlier than N 12, may suggest that this section represents the upper part of the subzone. However, the specimens recovered here differ slightly from typical *C. nipeensis* (see discussion, p. 34).

In connection with the López section I want to draw attention to a fauna from the Laguana and Bayaguana amber sites (Text-fig. 3) on the south flank of the eastern Central Cordillera, which I received from Dr. R. Below of the Friedrich Wilhelm University in Bonn, West Germany. This assemblage resembles the fauna of the López section with the exception of the occurrence of species of *Hemicyprideis* Malz and Triebel, 1970, and *Perissocytheridea* Stephenson, 1938, which suggests a lower salinity environment for the amber sites. The fauna also shows strong affinity to that of the Anguilla Formation in the Lesser Antilles and that of the Jealousy Formation of St. Croix (Bold, 1970b). The faunal relationships with the amber sites and Anguilla beds are shown in Table 5. They suggest in each case an age close to the early–middle Miocene boundary.

The overlying Arroyo López section contains assemblages of brackish-water and marine species, the first dominating in some samples, whereas in others the marine element is predominant (Table 4). The dominant brackish water form is *Perissocytheridea cahobensis* Bold, 1981, known from the Las Cahobas Formation (Haiti) and the Cercado Formation in the Río Cana and Río Gurabo sections. Only one specimen of *Cyprideis pascagoulaensis* (Mincher, 1941) was found; this species is quite common in the Las Cahobas and Cercado formations. The marine fauna consists almost entirely of species that are known from the upper Cercado and lower Gurabo formations: *Radimella confragosa* (Edwards, 1944), *R. ovata,* n. sp., *Hermanites hornibooki* (Puri, 1960), *Proteoconcha*? *evai,* n. sp., *Loxoconcha* (*Loxocorniculum*) *fischeri* (Brady, 1869), *L.* (*L.*) *dorsotuberculata* (Brady, 1866), *Xestoleberis duo,* n. sp. and *X. antillea,* n. sp., and including typical *Pellucistoma howei* Coryell and Fields, 1937, of the Gatun Formation of Panama. This fauna strongly suggests a late Miocene age (overlap of the ranges of *R. confragosa* and *C. pascagoulaensis*) and equivalence with the upper Cercado Formation of the Río Gurabo section.

The part of the section near Santiago de los Caballeros (Text-fig. 1 [sect. 7], contains a typical "Gurabo fauna" with added deeper-water species, such as *Cytherella postdenticulata* Oertli, 1961, *Krithe trinidadensis* Bold, 1958, and *Bradleya* ex gr. *dictyon* (Brady, 1880), common in the Mao Formation north of Santiago (*e.g.,* loc. H 15122; Bold, 1968, text-fig. 6, table 11), but absent in the Gurabo type section. Although no precise age determination can be made on the basis of the ostracodes, the assemblage is strongly suggestive of Pliocene.

PALEOECOLOGY

In the interpretation of the paleobathymetry and paleoecology I have relied extensively on unpublished work in the Caribbean by Patricia Fithian of Lousiana State University (1980), and by Llano (1978), Ramírez (1980) and Ramírez Castilla (1983), and on work in the Gulf of Mexico by Neal (1974) and by graduate students and myself on the Alacran reef. Published information on the distribution of Recent ostracodes of the Caribbean is contained in Baker and Hulings (1966), Bold (1978a), and Breman (1982), and on the Gulf of Mexico in Hulings (1967a), Puri and Hulings (1957), Puri (1960), Benda and Puri (1962), Hulings and Puri (1964), Benson and Coleman (1963), Krutak (1971, 1982a, 1982b, 1982c), Morkhoven (1972), and Maddocks (1974). In addition, I have used information from Hulings (1966), Hazel (1967a, 1967b, 1975a, 1975b) and Cronin (1983) on the distribution of ostracodes along the southern Atlantic coast of the United States and from Swain (1969), Swain and Gilby (1976), and Ishizaki and Gunther (1974, 1976) on distribution on the Pacific side of Central America.

In most cases the adult forms are accompanied by several of their molt stages, which makes it improbable that much displacement of the fauna occurred after deposition. There are a few exceptions to this rule and their implications will be discussed below.

Río Cana Section
(Text-figs. 1 [sect. 1], 5; Table 1)

The first brackish-water faunas are encountered about 100 m above the base of the Cercado Formation; the first marine fauna occurs about 165 m above the base: *Cytherella* Jones, 1850, *Macrocyprina* Triebel, 1960, *Radimella* Pokorný, 1969, *Caudites* Coryell and Fields, 1937, *Proteoconcha* Plusquellec and Sandberg, 1969, *Loxoconcha* (*Loxocorniculum*) Benson and Coleman, 1963, *Paracytheridea* Müller, 1894. A new brackish-water intercalation occurs between levels 185 and 225 m in alternating beds of lignite and beds with *Anadara* (*Larkinia*) *patricia* (Sowerby, 1850) (Caimito Formation of Maury, 1931). Depths of deposition in this whole section probably fluctuated between 0 and 30 m.

Above this second brackish-water interval the marine fauna becomes more diversified, and in addition to the earlier-mentioned taxa, the lower Gurabo Formation contains *Cytherella* sp. A of Bold, 1968, *Bairdoppilata* Coryell, Sample, and Jennings, 1935, *Gangamocytheridea* Bold, 1963b, *Pseudopsammocythere* Carbonnel, 1966, *Munseyella* Bold, 1957a, *Orionina* Puri, 1954, *Jugosocythereis* Puri, 1954, *Cativella* Coryell and Fields, 1937, *Puriana* Coryell and Fields, 1953b, *Loxoconcha* (*Loxoconcha*) Sars, 1866, *Kangarina* Coryell and Fields, 1937, and *Xestoleberis* Sars, 1866, indicating progressively farther offshore conditions. At about the 410 m level, the water depth may have reached more than 100 m, when deeper-water ostracodes appear, such as *Cytherella dominicana* Bold,

1968, *Argilloecia* spp., *Krithe dolichodeira* Bold, 1946, *Munseyella saundersi,* n. sp., *Loxoconcha* (*Palmoconcha*) *banesensis* Bold, 1946. This deeper-water interval lasts until about 470 m. Dimensions of *K. dolichodeira,* however, are below 0.5 mm, which indicates that water depths remained less than 200 m (see RÍO GURABO SECTION). In the upper 100 m of the Gurabo Formation a return to shallower-water conditions occurs.

The Mao Formation begins with about 100 m of barren sandstones and conglomerates followed by massive Mao Adentro limestones, which have yielded no washable samples. Only one sample, located at 980 m, contained any ostracodes. Species such as *Trachyleberidea mammidentata* (Bold, 1946), *Ambocythere exilis* Bold, 1966b, and *Loxoconcha* (*Palmoconcha*) *banesensis* indicate fairly deep deposition (as much as 200 m?) similar to that in the Mao Formation of the Río Gurabo section at about 750 m (Text-fig. 5).

RÍO GURABO SECTION
(Text-figs. 1 [sect. 2], 5; Table 2)

Just above the lignites in the Cercado Formation (about 50 m above the base) the first brackish-water faunas occur. Above these beds follow about 90 m of barren beds and barely 10 m below the base of the Gurabo Formation (level 140 m) the first marine fauna occurs, which becomes rapidly more diversified up section and contains species of *Bairdia* M'Coy, 1844, *Paranesidea* Maddocks, 1969, *Pseudopsammocythere* Carbonnel, 1966, *Radimella* Pokorný, 1969, *Caudites* Coryell and Fields, 1937, *Jugosocythereis* Puri, 1954, *Hermanites* Puri, 1955, *Proteoconcha* Plusquellec and Sandberg, 1969, *Cytheretta* Müller, 1894, *Loxoconcha* (*Loxocorniculum*) Benson and Coleman, 1963, *Cytheropteron* (*Cytheropteron*) Sars, 1866, *Paracytheridea* Müller, 1894, *Pseudoceratina* Bold, 1965a, *Microcythere* Müller, 1894, and *Xestoleberis* Sars, 1866. The assemblage indicates shallow-water marine deposition, but probably not shallower than about 30 m.

Just above the basal conglomerate of the Gurabo Formation (± 160 m level) the fauna becomes still more diversified and in addition contains species of *Cytherella* Jones, 1850, *Gangamocytheridea* Bold, 1963b, *Coquimba* Ohmert, 1968, *Pterygocythereis* Blake, 1933, *Cytherura* Sars, 1866, *Hemicytherura* Elofson, 1941, *Eucytherura* Müller, 1894. Very much the same fauna (with one occurrence of *Ambocythere* Bold, 1957c, which may indicate depositional depth of more than 100 m) continues to about the 360 m level, where the first specimens of *Krithe dolichodeira* Bold, 1946, make their appearance. These specimens are very small (less than 0.41 mm). In the Gulf of Mexico and on the Paria–Orinoco shelf this species occurs only below 180 m water depth, but the average size here is larger than 0.50 mm. The size of specimens of this species increases over the next 35 m (Text-fig. 6) to 0.55 mm (loc. NMB 15958, ± 400 m level) at which point many other deeper-water taxa appear: *Argilloecia* Sars, 1866, *Macrocypris* Brady, 1868, *Bythocypris* Brady, 1880, *Cytherella dominicana* Bold, 1968, *C.* sp. aff. *C. vulgata* Ruggieri, 1962, *Parakrithe alta,* n. sp., *Loxoconcha* (*Palmoconcha*) *banesensis* Bold, 1946, *Cytheropteron* (*Lobosocytheropteron*) *palton* Bold, 1966c, and *Pedicythere variabilis,* n. sp. Depth of deposition may have been greater than 200 m. At the same time there is a disappearance, or reduction in numbers, of shallow-water taxa such as *Macrocyprina* Triebel, 1960, *Bairdia* M'Coy, 1844, *Gangamocytheridea* Bold, 1963b, *Radimella* Pokorný, 1969, *Hermanites* Puri, 1955, *Coquimba* Ohmert, 1968, *Xestoleberis* Sars, 1866, and others.

A little higher in the section such deeper-water species as *Krithe lambi* Bold, 1966a, *Echinocythereis madremaestrae,* n. sp., *Brachycythere* sp. aff. *B. russelli* Howe and Lea, 1936, *Cytheropteron* (*Aversovalva*) *bijuduvali,* n. sp., and *Bythoceratina monoceros,* n. sp., appear for the first time. This type of faunal assemblage continues throughout the upper Gurabo and most of the Mao Formation, while the size of *Krithe dolichodeira* remains more or less constant at about 0.57–0.58 mm (Text-fig. 6). If we compare these dimensions with the size-graphs of Morkhoven (1972) and Bold (1981) it appears that a depth of deposition between 200 and 400 m is plausible. This also agrees with the occurrence of both *Costa dohmi* Bold, 1968, and *C. bellipulex* Levinson *in* LeRoy and Levinson, 1974 (though never as adults in the same sample) in this interval (430–670 m) (compare Bold, 1981, text-fig. 15). The record in the northern part of Hispaniola indicates that the latter species appears here somewhat earlier than originally thought.

In the Mao Formation the occasional return of shallow-water taxa, such as *Quadracythere* Hornibrook, 1952, *Hermanites* Puri, 1955, *Coquimba* Ohmert, 1968, and *Puriana* Coryell and Fields (in Puri, 1953b) and the occasional abundance of species of *Bairdia* M'Coy, 1844, and of *Radimella confragosa* (Edwards, 1944), may be indications of shallowing. Between localities NMB 16054 and 16097 (680–710 m) a regular influx of a few specimens of the brackish-water genus *Perissocytheridea* Stephenson, 1938, occurs, whereas the rest of the fauna and the size of specimens of *K. dolichodeira* Bold, 1946, would indicate only minor fluctuations in water depth. Therefore it seems likely that during the deposition of the Mao Formation there was considerably more downslope movement of the contemporary sediment than during deposition of the Gurabo Formation, and that an upper slope environment persisted, with occasional mixing with inner-shelf species. Little or no transport of specimens is suspected if a sample contains both adults and several molt stages

of the same species. In most of the samples within this interval only the deep-water species [*Cytherella* sp. aff. *C. vulgata, Argilloecia* spp., *Krithe dolichodeira* and *K. lambi, Brachycythere* sp. aff. *B. russelli* and *Loxoconcha* (*Palmoconcha*) *banesensis*] are represented by adults and molts, whereas the fewer shallow-water species are represented either by adults or by molts only (*e.g.,* species of *Radimella, Puriana, Orionina* Puri, 1954, *Uroleberis* Triebel, 1958).

Sample NMB 16090, which does not contain any deep-water species and in which both molts and adults of shallow-water species are present, could belong to a small subaqueous slide that maintained its sedimentary coherence.

There are two discrepancies with previous observations. Sample H 15448 of the Dominican Seaboard material, located between locs. NMB 16093 and 16097 (about 730 m level) contains *Krithe trinidadensis* Bold, 1958, *K. prolixa* Bold, 1966a, and *K. morkhoveni* Bold, 1960. The combination of these three species should be an indication of water-depth in excess of 700 m (Bold, 1981, fig. 14B). This is deeper than any fauna recorded in the present collection from the Río Gurabo and resembles conditions found farther east along the old Santiago–Puerto Plata road (Bold, 1968, table 12) and the Río Yaque del Norte near Santiago (Table 4).

In sample H 15242 (located between locs. NMB 16151 and 16148, ± 220 m level) a few specimens of *Cyprideis pascagoulaensis* (Mincher, 1941) occur. This return of brackish-water conditions in the lower Gurabo Formation may correlate with similar conditions in the *Anadara* (*Larkinia*) *patricia* beds of the uppermost Cercado Formation of the Río Cana section.

Río Mao Section
(Text-fig. 1 [sect. 3]; Table 3)

Only a few samples, mainly from the lower Gurabo Formation, were available. They show an earlier occurrence of *Krithe dolichodeira* Bold, 1946 than in the Río Gurabo section, and the length is greater (0.51 mm *vs.* 0.41 at the earliest occurrence in the Río Gurabo section). Although the fauna is generally indicative of relatively shallow water, the greater diversity of the fauna indicates farther offshore conditions than in the Río Gurabo section. In the upper Gurabo (*e.g.,* loc. TU 1292, 1.5–2 km upstream from Mao Adentro) deeper-water species are present: *Cytherella dominicana* Bold, 1968, *Argilloecia* spp., *Macrocypris* sp. 2, *Brachycythere* sp. aff. *B. russelli* Howe and Lea, 1936, and *Echinocythereis madremaestrae,* n. sp. Paleodepths at this level were probably similar to those in the Gurabo section between locs. NMB 15983 and 16020 (from about 50 m below the Gurabo–Mao contact to about 20 m above it). However, the dearth of samples in the upper Gurabo and Mao formations and the lack of stratigraphic control makes a more detailed interpretation impossible. Presence of *Krithe dolichodeira* Bold, 1946 (length up to 0.61 mm), *K. morkhoveni* Bold, 1960 and *Cytherella* sp. aff. *C. vulgata* Ruggieri, 1962, in the one sample (H 15207) of the Mao Formation indicates considerably deeper deposition than in the Río Gurabo section. The shallow-water species, *Radimella confragosa* (Edwards, 1944), *Orionina serrulata* (Brady, 1869) and *Paranesidea antillea* (Bold, 1946) occur as single specimens, and are probably redeposited downslope (for location, see Saunders, Jung, and Biju-Duval, 1986, text-figs. 30, 31).

Río Yaque del Norte Section
(Table 4)

The part of the Río Yaque del Norte included in the present study stretches from Baitoa in the south to the city of Santiago de los Caballeros, some 20 km downstream to the north. The lower (upstream) part of the section, here called the Baitoa section, yielded only a few specimens, which indicate a shallow-marine environment (probably inner shelf).

The unconformably overlying beds of the López section (Saunders, Jung, and Biju-Duval, 1986, text-fig. 25) contain a fauna that indicates a similar shallow-marine environment, but slightly deeper than that of the Anguilla Formation and the Laguana and Bayaguana amber sites (Table 4), where some taxa (*e.g., Hemicyprideis* Malz and Triebel, 1970) suggest slightly lower than normal salinities.

In the Arroyo López section, the predominance of *Perissocytheridea cahobensis* Bold, 1981, in some samples indicates local brackish-water environment, but the near absence of *Cyprideis pascagoulaensis* (Mincher, 1941) points to the presence of special conditions. This species may not have been able to tolerate fairly high salinities (as are suggested by the accompanying marine fauna), whereas *P. cahobensis* might have had a higher tolerance. In the Arroyo López section the latter species is always smooth and polished-looking (as is the single specimen of *C. pascagoulaensis*), a condition which Carbonel (1982) and Carbonel and Pujos (1982) relate to a fairly high calcium content of the water and a low Mg/Ca ratio. Carbonnel (1975) relates this phenomenon to increasing temperatures, whereas Bold (1976) thought it to be simply an indication of increased calcium content of the environment. Chivas, DeDecker, and Shelley (1983) point out that the Mg/Ca ratio in ostracode shells increases with increasing temperature so that the two factors may well be interrelated. The specimens of *P. cahobensis* in the Cercado Formation of the Río Gurabo and Río Cana

sections, and in the Las Cahobas Formation of Haiti (Bold, 1981) vary from smooth to lightly reticulate, and are always accompanied by punctate *C. pascagoulaensis*. This would suggest that the environment of the Arroyo López section is more calcitic than that of the Las Cahobas and Cercado formations (for location of samples, see Saunders, Jung, and Biju-Duval, 1986, text-figs. 21, 26).

The upper part of the section near Santiago contains large specimens of *Krithe trinidadensis* Bold, 1958 (more than 1 mm in length), which suggests that these beds were deposited in a deeper-water environment than was attained in the Río Gurabo section. This is confirmed by the presence of such deep-water species as *Cytherella postdenticulata* Oertli, 1961, and *Bradleya* ex gr. *dictyon* (Brady, 1880), together with a general absence of shallow-water taxa, except in a turbidite lens reported by Vokes (loc. TU 1227A). Conditions are similar to those reported earlier (Bold, 1968) in samples along the old Santiago–Puerto Plata road, and indicate an upper slope environment, in places possibly as deep as 1000 m.

CORRELATION BETWEEN RÍO CANA AND RÍO GURABO SECTIONS
(Text-fig. 5)

Although these sections are only about 5 km apart, there is a significant change in depositional characters with the Río Cana section always much shallower than the Gurabo one. In both sections the first marine faunas are found about 150 m above the base of the Cercado Formation. The *Radimella* event coincides with this facies change. However there is a second brackish-water interval in the Río Cana section 185–225 m above the base, and a similar occurrence of brackish-water beds intercalated between marine beds is found in the Río Guayabín farther west. In the Río Gurabo section there is only a doubtful indication of the proximity of brackish-water conditions at about the 200 m level (see p. 14). The base of the Gurabo Formation (at the 280 m level in the Río Cana, but about the 150 m level in the Río Gurabo) is marked by the first appearance in both sections of *Cytherella* sp. A of Bold, 1968, and *Gangamocytheridea*? *plicata* Bold, 1968.

Possible shallow-water marker species are *Radimella ovata*, n. sp. and *Coquimba congestocostata* (Bold, 1963b). These forms disappear just before or during a deepening of the environment at about the 315 m level in the Río Cana, about 395 m in the Río Gurabo.

Another observed possibly-correlatable horizon is the boundary between the distribution of *Munseyella jungi*, n. sp. and *M. saundersi*, n. sp., at 530 m in the Río Gurabo, and between 350 and 410 m in the Río Cana.

The most logical correlation is suggested by the two faunal changes: the lower one from brackish-water to marine, the second one representing a slight deepening in the Río Cana section at the 410 m level, and considerable deepening in the Río Gurabo section at the 380 m level (Text-fig. 5). In this case the base of the Gurabo Formation should rather be placed at the base of the conglomerates near loc. NMB 17002 in the Río Cana (180 m). The gradual faunal change between the Gurabo and Mao formations clearly shows that we are dealing with a single cycle of deposition, and that the "basal" conglomerate that marks the base of the Gurabo Formation in its type section, is only of very local significance. In view of these correlation difficulties, I should prefer to go back to Maury's original molluscan zonation of *Aphera islacolonis* and *Sconsia laevigata* zones instead of using the names "Cercado Formation" and "Gurabo Formation" (Bold, 1968, p. 40).

CONCLUSIONS

The sedimentary environment of the Río Cana section is always shallower than that of contemporaneous beds in the Río Gurabo section. Age-equivalent beds in the Río Mao section were deposited in slightly deeper water and this increase in depth is continued in the Río Yaque del Norte section and in beds exposed along the old Santiago–Puerto Plata highway (Bold, 1968, table 12). Therefore there is an increase in depth of deposition in a west–east direction as was previously noted (Bold, 1968).

Each marine section starts with a shallow-water facies (less than 30 m in depth) and shows an upward increase in depth of deposition. The greatest depth in the Río Cana section may have reached 200 m in the upper Gurabo and Mao formations. In the Río Gurabo section this depth may have been exceeded before the end of Gurabo deposition and depths could have reached more than 400 m in the Mao Formation. In the Río Mao section, similar depths may have been attained already in the upper part of the Gurabo Formation, while in the Santiago section (and along the old Santiago–Puerto Plata highway), the depth of deposition may have been near 1000 m.

In all sections this increase in depth is slow and gradual (with fluctuations in the Río Guayabín and Río Cana sections) and there is no sudden change in conditions at formational boundaries. In fact, the Cercado, Gurabo and Mao formations clearly belong to a single cycle of deposition during late Miocene and Pliocene. On the basis of ostracode assemblages there is no clear distinction between formations. The Cercado Formation is continental to brackish in nature, but the marine invasion takes place before the end of Cercado deposition. The Gurabo Formation is of inner-shelf to

outer-shelf environment and may include (especially in the Santiago section) upper slope deposits. The Mao Formation varies from outer-shelf to upper continental slope. Similar environments occur at different times in the different sections. Moreover this east–west transgression was not a continuous one as suggested by the intercalation of brackish-water beds between marine horizons in the Río Cana and Río Guayabín sections (Bold, 1968, table 4).

SYSTEMATIC PALEONTOLOGY

INTRODUCTION

In paleontology, we are dealing normally with morphospecies. In the case of Ostracoda, fossil species are based exclusively on the morphology of the shell, which, however, is an integral part of the animal's body and therefore reflects part of the soft-part morphology, *e.g.*, muscle attachments, eyes, pores (sensory hairs). In neontology, ostracode species may be recognized on the basis of their appendages and color markings, and they sometimes cannot be distinguished solely on the basis of carapace morphology. This is especially the case in the Cypridacea and, to a lesser degree in the Bairdiacea and Platycopina and in some of the Cytheracea (*e.g.*, Paradoxostomidae, Xestoleberididae). For this reason, several of the unornamented forms with uncharacteristic outer morphology have been kept in open nomenclature in the past and only a few of them have been systematically described and named in this report. This is done to avoid further proliferation of unnamed species and to lessen confusion with species in open nomenclature in previous publications both by myself and by other authors. Some forms are compared to previously-named species and prefixes have been used in the following sense: **aff.** (related to, but not identical); **cf.** (similar in general morphology, but not identical and probably not even related); **ex gr.** (related to, and may be placed within the species mentioned if a rather wide range of variability is accepted).

A species name may be followed by a question mark, indicating that these specimens may be identical to the previously-described species, but that identification is uncertain because of poorly-preserved present or original material, or insufficient original description and/ or poor illustration. This may occasionally overlap with the **ex gr.** category.

If a generic name is followed by a question mark it indicates that the species may not belong to that particular genus (within its presently-accepted limits), but that there is not sufficient evidence to separate it at this time. A generic name put in quotation marks indicates that in my opinion the species belongs to a new and undescribed genus, but that this is not the place to establish such a genus. Holotypes of previously-published species are referred to by their Museum Collection number, their type locality and its stratigraphic horizon. In a few cases the names of the repositories are quoted in full, but in the majority of cases acronyms have been used as follows:

AMNH: American Museum of Natural History, New York, NY, U.S.A.

BM(NH): British Museum (Natural History), London, England, U.K.

FGS: Florida Geological Survey, Tallahassee, FL, U.S.A.

GIRU: Geological Institute of the Rijksuniversiteit, Utrecht, Netherlands.

HVH: H. V. Howe collections, Louisiana State University, Baton Rouge, LA, U.S.A.

NMCM: Ministerio de Minería, Combustibles y Metalurgía, Archivo Micropaleontológico, Habana, Cuba.

USGS: U. S. Geological Survey, Washington, DC, U.S.A.

USNM: U. S. National Museum of Natural History (Smithsonian Institution), Washington, DC, U.S.A.

The type (and other) localities of the present species are referred to by the locality numbers of the Natural History Museum of Basel, Switzerland. These locality numbers have received a prefix "NMB". Samples of the Dominican Seaboard Oil Company, collected by C. F. Dohm, and studied by Bermúdez (1949) and Bold (1968) have the prefix "H". Samples with prefix "TU" were collected by Emily and Harold Vokes of Tulane University. When reference is made to a species in open nomenclature from a previous publication, the deposited material is called "Reference material", with a "Reference locality" and stratigraphic horizon.

Dimensions are in millimeters; L = length, H = height, W = width.

Illustrated and measured specimens are identified by their catalogue number in the H. V. Howe collections, except in some cases (especially if only a single individual was recovered from a locality), where the measured specimens have been left in the assemblage slides of Bold's private collection (Department of Geology, Louisiana State University, Baton Rouge, LA, U.S.A.). These assemblage slides are catalogued by their NMB or TU locality numbers or by their locality names (*e.g.*, Laguana and Bayaguana amber sites), and by position on the slide ("No."). The reason for not adding them to the H. V. Howe collection is the continued use of these slides while research in the Dominican Republic is progressing. Removing the specimens from the assemblage slides would, in some cases, have completely removed the species from these slides, which could cause confusion during further study.

At the end of the descriptions the heading "Occur-

rence" gives the distribution within the present study area (northern Dominican Republic). Details of these occurrences are given in Tables 1–4. The heading "Distribution" gives the stratigraphic and geographic distribution of the species within the area of the U. S. Atlantic and Gulf coastal plains, Mexico and the Caribbean (Central America, northern South America, the Lesser and Greater Antilles, and the Bahamas). For each species the number of specimens studied in the present material (Cibao Valley only) is given under the heading "Material".

SYSTEMATICS

Order **PODOCOPIDA** Müller, 1894

Suborder **PLATYCOPINA** Sars, 1866

Genus **CYTHERELLA** Jones, 1850

GROUP 1

SHALLOW-MARINE SPECIES
(Bold, 1981, p. 54)

Cytherella caelata Bold

Cytherella caelata Bold, 1963b, p. 370, pl. 1, figs. 1a–d; Bold, 1968, tables 6, 11; Bold, 1970a, table 1; Bold, 1972a, table 2; Bold, 1975c, table 2.

Diagnosis.—A species of *Cytherella* with punctate carapace and slightly raised rims at both ends, transitional to *Cytherelloidea* Alexander, 1929.

Holotype.—HVH No. 6835.

Type locality.—Loc. R 11862, Melajo River, Trinidad.

Stratigraphic horizon.—Melajo clay member of the Springvale Formation (Pliocene).

Dimensions.—Right valve, L: 0.56; H: 0.32; W: 026 (loc. NMB 16172, No. 25).

Material.—Four specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Pliocene: Trinidad, Venezuela, Dominican Republic, Cuba.

Cytherella species aff. **C. pandora** Kornicker

Cytherella sp. aff. *pandora* Kornicker. Bold, 1966d, pl. 2, fig. 1.
?*Cytherella pandora* Kornicker, 1963, p. 69, figs. 25–29, 43–44; Baker and Hulings, 1966, p. 114, pl. 1, fig. 15.

Diagnosis.—A species of *Cytherella,* elongate subrectangular in shape, with slightly concave dorsal and ventral margins; surface covered with small, oval punctations.

Holotype.—USNM 117C-2.

Type locality.—Bimini, Bahamas.

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 8256.

Reference locality.—Coco Solo borehole 9 at 31.5 ft, Colón, Panama.

Stratigraphic horizon.—Recent.

Dimensions.—Right valve, L: 0.63; H: 0.33 (loc. TU 1443, No. 1).

Material.—One specimen.

Occurrence.—Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Recent.

Cytherella species aff. **C. pulchra** Brady

Cytherella sp. aff. *C. pulchra* Brady. Bold, 1957b, p. 235, pl. 1, fig. 1; Bold, 1963b, table 5; Bold, 1965b, p. 386, pl. 1, fig. 4; Bold, 1975a, tables 2, 5, 6, 9.

Diagnosis.—A species of *Cytherella* with parallel, slightly concave dorsal and ventral margins and rounded, almost equal ends.

Reference material.—HVH No. 8826.

Reference locality.—Loc. 6795, east of Palma Dulce, Enriquillo Basin, Dominican Republic (Bold, 1975c, p. 555, text-fig. 11).

Stratigraphic horizon.—Jimaní Formation (Plio-Pleistocene).

Dimensions.—HVH No. 10800 (right valve), L: 0.57; H: 0.32; HVH No. 10800 (left valve), L: 0.55; H: 0.30 (loc. NMB 15937).

Material.—More than 70 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3). Río Yaque del Norte (López, Arroyo López, Santiago): (Table 4). Laguana amber site: (Table 5).

Distribution.—Oligocene to Recent: Caribbean.

Cytherella species aff. **C. semitalis** Brady

Cytherella sp. Bold, 1968, p. 43, pl. 1, figs. 2, 3, tables 4, 5, 9, 11.
Cytherella sp. aff. *C. semitalis* Brady. Bold, 1981, p. 55, pl. 1, fig. 1.

Diagnosis.—A species of *Cytherella* with deep punctations except in the center of the valves, obliquely-rounded posterior and evenly-rounded anterior end.

Reference material.—HVH No. 9998.

Reference locality.—Rivière Féliciane, west of Muscady, Central Haiti (Bold, 1981, text-fig. 8).

Stratigraphic horizon.—Las Cahobas Formation (Pliocene?).

Dimensions.—Left valve, L: 0.59; H: 0.38 (loc. NMB 16106, No. 1).

Material.—Thirteen specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Recent: Hispaniola; Recent: Gulf of Mexico.

Cytherella species A

Cytherella sp. A. Bold, 1968, p. 42, pl. 1, figs. 4a, b, tables 5, 7, 9, 10.

Diagnosis.—A species of *Cytherella* of elliptical outline, with a submedian, dorsal, vertical sulcus; wedge-shaped in dorsal view, widest posteriorly.
Reference material.—HVH No. 8320.
Reference locality.—Loc. H 15117, Río Yaque del Norte, Dominican Republic (Bold, 1968, text-fig. 6).
Stratigraphic horizon.—Baitoa Formation (middle Miocene).
Dimensions.—Right valve, L: 0.54; H: 0.31 (loc. NMB 17189, No. 13).
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (López): (Table 4).

GROUP 2

DEEPER-MARINE SPECIES (ABYSSAL TO OUTER-NERITIC) (Bold, 1981)

Cytherella species aff. **C. vulgata** Ruggieri

Cytherella sp. aff. *C. vulgata* Ruggieri. Bold, 1968, p. 40, pl. 2, fig. 2, tables 4, 7–9, 11, 12; Bold, 1971b, tables 1, 4, 5; Bold, 1972a, table 4; Bold, 1975a, table 13; Bold, 1981, p. 55, pl. 1, fig. 3, tables 2, 12, 14, 15.

Diagnosis.—A species of *Cytherella,* broadly rectangular in outline with papillate posterior part and wedge-shaped dorsal view, slightly compressed in the middle.
Reference material.—HVH No. 8314.
Reference locality.—Loc. H 15000, old Santiago–Puerto Plata road, Dominican Republic (Bold, 1968, text-fig. 7).
Stratigraphic horizon.—"Mao Formation" (Pliocene).
Dimensions.—Right valve, L: 0.79; H: 0.46 (loc. NMB 17196, No. 2).
Material.—About 40 specimens.
Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao (Table 3). Río Yaque del Norte (Santiago): (Table 4).
Distribution.—Oligocene to Pleistocene: Trinidad, Hispaniola, Jamaica.

Cytherella dominicana Bold

Cytherella dominicana Bold, 1968, p. 41, pl. 1, figs. 1a–e, tables 7, 8, 11; Bold, 1971b, table 5; Steineck, 1981, pl. 1, fig. 15.

Diagnosis.—A species of *Cytherella* with heavy, subovate carapace, exhibiting a deep central pit and strong sexual dimorphism.
Holotype.—HVH No. 8317.
Type locality.—Loc. H 15101, on old Santiago–Puerto Plata road, Dominican Republic (Bold, 1968, text-fig. 7).
Stratigraphic horizon.—"Mao Formation" (Pliocene).
Dimensions.—HVH No. 10802 (right valve, female), L: 0.75; H: 0.51; HVH No. 10802 (left valve, female), L: 0.72; H: 0.45; HVH No. 10802 (right valve, male), L: 0.79; H: 0.52; HVH No. 10802 (left valve, male), L: 0.76; H: 0.48 (all from loc. NMB 15973).
Remarks.—Dimensions of the type material are conspicuously larger, which may be due to the fact that this material comes from considerably deeper-water environment than the present material.
Material.—More than 100 specimens.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).
Distribution.—Oligocene: Jamaica; middle Miocene: Trinidad; Pliocene: Dominican Republic, Jamaica.

Cytherella species B

Cytherella sp. B. Bold, 1968, p. 43, pl. 1, figs. 5a, b, tables 4, 9, 11; Bold, 1969, p. 120, table 1.

Diagnosis.—A species of *Cytherella* with the posterior end much higher than the anterior.
Reference material.—HVH No. 8321.
Reference locality.—Maury's Bluff 1 on the Río Mao (loc. H 15212), Dominican Republic (Bold, 1968, text-fig. 4).
Stratigraphic horizon.—Gurabo Formation (upper Miocene).
Dimensions.—HVH No. 10801 (right valve), L: 0.59; H: 0.32 (loc. NMB 17011).
Material.—Ten specimens.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).
Distribution.—Middle Miocene–Pliocene, Greater Antilles.

Cytherella postdenticulata Oertli

Cytherella postdenticulata Oertli, 1961, p. 19, pl. 1, figs. 1–11; Bold, 1981, p. 55, pl. 1, fig. 2 (with synonymy).

Diagnosis.—A species of *Cytherella* of ovoid shape, with the ventral margin slightly concave; posterior end papillate.
Holotype.—Geological Institute, University of Milano, Italy, No. 1339.
Type locality.—Brice della Croce section (lower part), Type Langhian, Italy.
Stratigraphic horizon.—Lower Langhian.

Dimensions.—Right valve, L: 0.86; H: 0.55 (loc. NMB 17196, No. 3).
Material.—Five specimens.
Occurrence.—Río Yaque del Norte (Santiago): (Table 4).
Distribution.—Middle Miocene–Pliocene: Caribbean; Aquitanian–Tortonian: Italy.

Genus **CYTHERELLOIDEA** Alexander, 1929

Cytherelloidea species B
Plate 1, figure 1

Cytherelloidea sp. B. Bold, 1966d, pl. 4, fig. 10.
Cytherelloidea sp. Bold, 1968, tables 4, 10; Bold, 1975c, tables 2, 4 (part).
Cytherelloidea umbonata Edwards. Teeter, 1975, p. 490, figs. 23n–o [not *C. umbonata* Edwards, 1944].

Diagnosis.—A species of *Cytherelloidea,* similar in many respects to *Cytherelloidea umbonata* Edwards, 1944 (p. 506, pl. 85, figs. 1, 2), but with steeper posterodorsal slope and more dorsally-extended posterior ridge.
Reference material.—HVH No. 8258.
Reference locality.—Colón Harbor, Panama.
Stratigraphic horizon.—Recent.
Dimensions.—Left valve (destroyed), L: 0.62; H: 0.37 (loc. NMB 16180).
Material.—Seven specimens.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2).
Distribution.—Upper Miocene (Greater Antilles) to Recent (Central America, Gulf of Mexico).

Cytherella species

Scattered specimens of possibly more than one unidentified species of *Cytherella* are found in the sections of the Río Mao (Table 3), Río Yaque del Norte (López) (Table 4) and the Bayaguana amber site (Table 5).

Suborder **PODOCOPINA** Sars, 1866

Superfamily **CYPRIDACEA** Baird, 1850

Family **PONTOCYPRIDIDAE** Müller, 1894

Genus **PONTOCYPRIS** Sars, 1866

Pontocypris ex gr. **dreikanter** (Coryell and Fields)
Plate 1, figure 3

aff. *Macrocypris dreikanter* Coryell and Fields, 1937, p. 4, pl. 1, figs. 4a, b.
Erythrocypris dreikanter (Coryell and Fields). Bold, 1946, p. 63, pl. 3, fig. 3.
Pontocypris dreikanter (Coryell and Fields). Bold, 1958, p. 397, pl. 2, figs. 2a, b; Bold, 1978b, table 8.
Not *Pontocypris dreikanter* (Coryell and Fields). Neufville, 1979, p. 143, pl. 3, figs. 6a, b.

Diagnosis.—A triangular species of *Pontocypris.*
Reference material.—GIRU D 27014.
Reference locality.—Loc. T 1439, 2 km SW of Banes on road to Santa Isabel de Nipe, Oriente Province, Cuba.
Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (= Júcaro Formation of Kozary, 1957, according to Jakus, 1983, p. 62).
Dimensions.—HVH No. 10482 (left valve), L: 0.62; H: 0.31 (loc. NMB 17011).
Material.—Eight specimens.
Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2).
Distribution.—Upper Miocene to Recent: Cuba, Hispaniola, Costa Rica.

Pontocypris species
Plate 1, figures 9, 10

Paracypris sp. Bold, 1968, p. 47 (part) [not pl. 2, fig. 6].
Paracypris sp. 2. Bold, 1969, pl. 1, figs. 4a, b; Bold, 1975a, tables 2, 4 (part); Bold, 1975d, table 1.

Diagnosis.—A species of *Pontocypris,* elongate triangular in side view with the greatest height just anterior to one-third of the length; posterodorsal margin slightly concave just anterior to the posterior extremity; dorsal view elongate bomb-shaped with the greatest width just anterior to one-third of the length; right valve slightly larger than left and overlapping along the entire periphery.
Reference material.—HVH No. 8741.
Reference locality.—Ponce Cement Quarry, Puerto Rico.
Stratigraphic horizon.—Ponce Formation *s. s.* (Mio-Pliocene).
Dimensions.—HVH No. 10491 (carapace), L: 1.09; H: 0.45; W: 0.31 (loc. NMB 16184).
Material.—Nine specimens.
Occurrence.—Río Gurabo: Cercado and Gurabo formations (Table 2). Río Mao: (Table 3).
Distribution.—Upper Miocene to Pliocene: Hispaniola, Puerto Rico, Cuba.

Genus **PROPONTOCYPRIS** Sylvester-Bradley, 1947

Propontocypris varaderoensis
Lubimova and Sánchez-Arango
Plate 1, figure 2

Propontocypris sp. Bold, 1968, p. 20, pl. 4, fig. 11, tables 7, 11; Bold, 1971b, table 6; Bold, 1975c, table 2; Bold, 1978b, table 9; Bold, 1981, p. 107.
Propontocypris? *varaderoensis* Lubimova and Sánchez-Arango, 1974, p. 74, pl. 6, figs. 7, 7a.

Diagnosis.—A species of *Propontocypris* with almost triangular outline, highest submedially with subequal slopes anteriorly and posteriorly.
Holotype.—NMCM H-20-06.

Type locality.—Varadero well #1: 60 m, Matanzas, Cuba.

Stratigraphic horizon.—Mio-Pliocene.

Dimensions.—HVH No. 10481 (right valve), L: 0.65; H: 0.47 (loc. NMB 16137).

Material.—Twenty-eight specimens.

Remarks.—*Propontocypris varaderoensis* is more sharply pointed posteriorly than *P. edwardsi* (Cushman) [see Cronin, 1979, p. 142, pl. 17, fig. 8].

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Recent: Greater Antilles, Costa Rica.

Genus **ARGILLOECIA** Sars, 1866

Argilloecia vespa, new species
Plate 1, figure 4

Argilloecia sp. cf. *A.* sp. 1. Bold, 1971b, p. 337, pl. 3, fig. 2.

Etymology of name.—(L.) *vespa* = wasp [because of the "sting-shaped" curvature of the posterior end].

Diagnosis.—A species of *Argilloecia* with a hook-like posterior curve, especially well-developed in the right valve.

Holotype.—HVH No. 10483.

Paratypes.—HVH No. 10484 (one left valve, two right valves), HVH No. 10485 (one left valve, and one right valve).

Type locality.—Loc. NMB 16020, Río Gurabo section.

Stratigraphic horizon.—Basal Mao Formation.

Description.—Carapace small, elongate, highest just posterior to the middle. Anterior margin in the right valve only slightly obliquely-rounded; dorsal margin strongly convex, with long, curved slope towards the subventrally-situated posterior end; ventral margin sinuate, slightly concave just in front of the middle, strongly convex in anterior and posterior part, becoming concave just in front of the posterior extremity. The left valve has similar shape, but the anterior end is more obliquely-rounded, and the posteroventral margin is less concave. Right valve overlapping the left along the entire margin, strongest dorsally and mid-ventrally. Interior typical for the genus, marginal area wide in anterior end with large vestibule.

Dimensions.—HVH No. 10483 (carapace, holotype), L: 0.39; H: 0.18; W: 0.16 (loc. NMB 16020); HVH No. 10484 (left valve), L: 0.43; H: 0.20 (loc. NMB 16020); HVH No. 10484 (right valve), L: 0.42; H: 0.20 (loc. NMB 16020).

Material.—Fifty-five specimens.

Remarks.—The peculiar "sting-like" posterior end sets this species apart. The only similar form in this respect is *Protoargilloecia angulata* Deltel, forme "acuminée" of Ducasse, 1983 (pl. 1, figs. 9–19, especially figs. 13, 15, 16) from the late Eocene and early Oligocene of the Aquitaine Basin (France).

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Pliocene: Jamaica, Hispaniola.

Argilloecia species cf. **A. vespa**, new species
Plate 1, figure 7

Diagnosis.—An elongate species of *Argilloecia* with a turned-up anterior end in the left valve, an obliquely-truncate posterior end, and a small concavity in the posteroventral margin of both valves, just in front of the posterior extremity. The shape of anterior and posterior ends is reminiscent of *A. vespa,* n. sp., but the length/height ratio is much greater.

Dimensions.—HVH No. 10489 (carapace), L: 0.51; H: 0.20 (loc. NMB 16020).

Material.—Fourteen specimens.

Remarks.—The similarity with *A. vespa* might suggest that this is the male of that species. However, this would mean an unusually strong sexual dimorphism, something that has not been encountered in *Argilloecia.*

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Argilloecia species 1

Argilloecia sp. 1. Bold, 1971b, p. 337, pl. 3, figs. 1a–c, pl. 4, figs. 1a, b; Bold, 1981, p. 58.

Reference material.—HVH No. 8792.

Reference locality.—Loc. J 3a, Port Morant, Jamaica.

Stratigraphic horizon.—Bowden Formation (middle Pliocene).

Dimensions.—HVH No. 10486 (left valve), L: 0.38; H: 0.20 (loc. NMB 15978).

Material.—Fifty-five specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Pliocene to Pleistocene: Jamaica, Hispaniola.

Argilloecia species 2
Plate 1, figure 5

Argilloecia sp. 2. Bold, 1968, p. 47; Bold, 1971b, p. 337, pl. 3, fig. 3, pl. 4, figs. 2a, b.
?*Argilloecia* sp. A. Cronin, 1983, pl. 7, figs. G, I.

Reference material.—HVH No. 8794.

Reference locality.—Loc. J 3a, Port Morant, Jamaica.

Dimensions.—HVH No. 10487 (carapace), L: 0.48; H: 0.50 (loc. NMB 16020).

Material.—Seventy-seven specimens.
Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).
Distribution.—Pliocene to Recent, Dominican Republic, Jamaica; Recent: Gulf of Mexico (varying in depth from 107–1070 m).

Argilloecia species 3
Plate 1, figure 6

Argilloecia sp. 3. Bold, 1971b, p. 337, pl. 3, fig. 4.
Argilloecia sp. 1. Steineck, 1981, p. 361.

Reference material.—HVH No. 8795.
Reference locality.—Loc. J 3a, Port Morant, Jamaica.
Dimensions.—HVH No. 10488 (carapace), L: 0.46; H: 0.22 (loc. NMB 16020).
Material.—Fifty-four specimens.
Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Cercado, Gurabo and Mao formations (Table 2).
Distribution.—Lower Miocene to Pliocene: Dominican Republic, Jamaica.

Argilloecia species
Plate 1, figure 8

Argilloecia sp. 1. Bold, 1968, p. 47, pl. 4, fig. 4, pl. 8, fig. 4.
Argilloecia sp. 7. Steineck, 1981, p. 361.

Reference material.—HVH No. 8291.
Reference locality.—Loc. H 15244, Río Gurabo, Dominican Republic (Bold, 1968, text-fig. 3).
Stratigraphic horizon.—Gurabo Formation (upper Miocene).
Dimensions.—HVH No. 10490 (right valve), L: 0.39; H: 0.20 (loc. H 15244).
Material.—Fifty specimens.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).
Distribution.—Lower Miocene to Pliocene: Jamaica, Dominican Republic; ?Recent: Trinidad.

Family **PARACYPRIDIDAE** Sars, 1925

Genus **PARACYPRIS** Sars, 1866

Paracypris species B

Paracypris sp. B. Bold, 1970b, p. 42, pl. 2, fig. 14.

Reference material.—HVH No. 8733.
Reference locality.—Crocus Bay, Anguilla.
Stratigraphic horizon.—Anguilla Formation.
Dimensions.—HVH No. 10803 (carapace), L: 0.82; H: 0.40; W: 0.32 (Bayaguana amber site).
Material.—Four specimens.
Occurrence.—Bayaguana amber site: (Table 5).
Distribution.—Lower to middle Miocene: Northern Lesser Antilles, Hispaniola.

Genus **TRIANGULOCYPRIS** Teeter, 1975

Triangulocypris pachyconcha (Bold)

Bythocypris pachyconcha Bold, 1946, p. 67 (part), pl. 1, fig. 11.
Paracypris sp. Bold, 1968, p. 47 (part), pl. 2, fig. 6, tables 5, 7, 9; Bold, 1975c, table 1.
Bythocypris keiji Bold. Bold, 1968, tables 4, 7, 9, 11 (not *B. keiji* Bold, 1963b, p. 374, pl. 1, figs. 7a, b, pl. 12, fig. 10).
Paracypris sp. 1. Bold, 1969, pl. 1, figs. 3a, b, table 1.
Disopontocypris pachyconcha (Bold). Bold, 1975c, p. 140, pl. 14, fig. 8, table 4.

Holotype.—GIRU S 12967.
Type locality.—Loc. T 1081A, Loma La Cruz, Santiago de Cuba.
Stratigraphic horizon.—La Cruz Formation (Pliocene).
Dimensions.—Right valve, L: 0.79; H: 0.47 (loc. NMB 16090, No. 3).
Material.—About 40 specimens.
Remarks.—*Bythocypris laeva* Puri, 1960 (p. 132, pl. 5, figs. 5, 6, not pl. 6, figs. 11–13) (holotype: FGS S 5233, paratypes: HVH No. 4772), differs from both *B. pachyconcha* and *B. keiji* by its gently-curved dorsal margin and fairly high anterior end. In the other two species the dorsal margin is angled at the greatest height. This angulation is much stronger in *T. pachyconcha.*
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).
Distribution.—Upper Miocene to Pliocene, Greater Antilles.

Family **MACROCYPRIDIDAE** Müller, 1894

Genus **MACROCYPRIS** Brady, 1868

Macrocypris species 1
Plate 1, figures 11, 12

Macrocypris sp. Bold, 1971b, p. 337, pl. 1, figs. 7a, b.
?*Macrocypris* sp. 2. Steineck, 1981, p. 361, text-fig. 8, table 2.
?*Macrocypris bathyalensis* Hulings. Cronin, 1983, pl. 4, fig. C (male) [not figs. A, B].

Diagnosis.—An extremely elongate species of *Macrocypris.*
Reference material.—HVH No. 8797.
Reference locality.—Loc. J 3a, Port Morant, Jamaica.
Stratigraphic horizon.—Bowden Formation (middle Pliocene).
Dimensions.—HVH No. 10492 (left valve), L: 1.02; H: 0.25 (loc. NMB 16097); HVH No. 10493 (right valve), L: 0.86; H: 0.28 (loc. NMB 16039).
Material.—Two specimens.
Remarks.—The species figured by Steineck from the lower Miocene of Jamaica has a slightly higher anterior

end and a more steeply-truncate posterior one. Although the lower Miocene and the Pliocene forms are closely related, they are probably not identical. The species figured by Cronin as the male of *M. bathyalensis* may be identical, but the female (?) has not been found in the material from the Dominican Republic.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Pliocene and Pleistocene: Jamaica, Dominican Republic; ?Recent in the Florida strait (136–1029 m).

Macrocypris species 2
Plate 1, figure 13

Diagnosis.—A species of *Macrocypris,* highest just in front of the middle, posterior end forming a slightly downwardly-curved beak; ventral margin almost straight.

Dimensions.—HVH No. 10494 (left valve), L: 1.00; H: 0.31 (loc. NMB 16030); HVH No. 10494 (right valve), L: 1.07; H: 0.38 (loc. NMB 16030).

Material.—Five specimens.

Remarks.—*Macrocypris* sp. 2 is very similar to *Macrocypria elegantula* Whatley and Downing, 1983 (p. 353, pl. 4, figs. 14–16) from the middle Miocene of Australia, but differs by the lesser concavity of the dorsal slope of the posterior end in the right valve.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Genus **MACROCYPRINA** Triebel, 1960

Macrocyprina species
Plate 1, figure 14

Macrocypris decora (Brady). Bold, 1968, tables 7, 9.
Macrocyprina maculata (Brady). Bold, 1966d, pl. 1, figs. 5a, b.
Macrocyprina sp. aff. *M. maculata* (Brady). Bold, 1978b, tables 2, 9.

Diagnosis.—A species of *Macrocyprina* with a low anterior end, highly-arched dorsal margin and obliquely truncate posterior end, which is rather sharply-pointed ventrally.

Reference material.—HVH No. 8267.

Reference locality.—Colón Harbor, Panama.

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 6324.

Reference locality.—*Atlantis* cruise 1947, 27°49.3′N, 91°53′W, Gulf of Mexico (Rothwell, 1949).

Stratigraphic horizon.—Recent (42–128 m).

Dimensions.—HVH No. 10495 (left valve), L: 1.03; H: 0.39 (loc. NMB 16156).

Material.—Twenty-three specimens.

Remarks.—This species is similar to those described earlier by Bold (*e.g.,* Bold, 1946) under the name *Macrocypris decora* (Brady) from the lower and middle Miocene of the Caribbean, and to *Macrocypris* sp. of Maddocks, 1974 (pl. 1, figs. 14, 15) from the Gulf of Mexico, but it is more sharply-pointed posteriorly.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene–Recent: Caribbean, Gulf of Mexico.

Superfamily **BAIRDIACEA** Sars, 1888

Family **BAIRDIIDAE** Sars, 1888

Genus **BYTHOCYPRIS** Brady, 1880

Bythocypris species

?*Bythocypris* sp. Bold, 1946, p. 68, pl. 3, figs. 11a, b.
?*Bythocypris* sp. Bold, 1963b, p. 375, pl. 1, fig. 8.

Diagnosis.—A thin-shelled, fragile, elongate species of *Bythocypris* with very blunt anterior and almost parallel (slightly arched) dorsal and ventral margins and obliquely-truncate posterior end.

Reference material.—GIRU D 27061.

Reference locality.—Loc. T 1451, Bahia de Nipe, West of Antilles, Oriente Province, Cuba.

Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (= Júcaro Formation of Kozary, 1957, Jakus, 1983, p. 62).

Dimensions.—Left valve, L: 0.60; H: 0.30 (loc. NMB 15933, No. 11).

Material.—One specimen.

Remarks.—The Cuban species has a somewhat blunter posterior end, but is otherwise quite similar in shape and size (L: 0.62). The same is true for the species from Trinidad.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Distribution.—?Upper Miocene: Cuba; Pliocene: Dominican Republic, ?Trinidad.

Genus **BAIRDIA** M'Coy, 1844

Bairdia longisetosa Brady

Bairdia longisetosa Brady, 1902, p. 197, pl. 25, figs, 8, 9; Bold, 1968, p. 48, pl. 2, figs. 3a, b (with synonymy); Bold, 1975a, pp. 585, 586, 589, 590, 593; Bold, 1978b, table 9.
Neonesidea longisetosa (Brady). Teeter, 1975, p. 117, figs. 3a, 4a.

Holotype.—Zoological Museum, Copenhagen, Denmark.

Type locality.—St. Thomas, Virgin Islands.

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 8293.

Reference locality.—Loc. H 15092, old Santiago–Puerto Plata road, Dominican Republic (Bold, 1968, text-fig. 6).

Stratigraphic horizon.—Mao Formation (Pliocene).

Dimensions.—HVH No. 10804 (left valve, L: 1.15; N: 0.75 (loc. NMB 16103).

Material.—About 40 specimens.

Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Cercado, Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Recent: Caribbean.

Bairdia species aff. **B. formosa** Brady
Plate 1, figure 18

Bairdia sp. aff. *B. formosa* Brady. Bold, 1968, p. 48, pl. 2, figs. 5a, b; Bold, 1972a, table 4.

Diagnosis.—An oval-shaped species of *Bairdia* (possibly *Paranesidea*) with strongly-dentate ends.

Reference material.—HVH No. 8292.

Reference locality.—Loc. H 15092, old Santiago–Puerto Plata road, Dominican Republic (Bold, 1968, text-fig. 6).

Stratigraphic horizon.—Gurabo Formation.

Dimensions.—HVH No. 10498 (left valve), L: 0.55; H: 0.33 (loc. NMB 16970).

Material.—Twenty-five specimens.

Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Bairdia laevicula Edwards

Bairdia laevicula Edwards, 1944, p. 506, pl. 55, figs. 3, 4; Swain, 1952, p. 17; Puri, 1954, p. 223, pl. 1, fig. 7; Hall, 1965, p. 27, pl. 1, fig. 7; Baker and Hulings, 1966, p. 114, pl. 1, fig. 18; Swain, 1968, p. 7, pl. 1, figs. 4a, b, pl. 7, fig. 2, text-fig. 5; Bold, 1975c, p. 139, pl. 25, figs. 9, 10.

Diagnosis.—An ovate, rather high species of *Bairdia* with flattened dorsal margin and rather blunt ends.

Holotype.—USNM 559411.

Type locality.—Natural Well, North Carolina.

Stratigraphic horizon.—Upper Duplin marl (Pliocene).

Dimensions.—HVH No. 10805 (carapace), L: 1.04; H: 0.65 (loc. NMB 16182).

Material.—Eight specimens.

Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Cercado and Gurabo formations (Table 2).

Distribution.—Upper Miocene to Recent: Atlantic Coastal Plain, Gulf Coast, Cuba, Dominican Republic; Recent: Puerto Rico.

Bairdia species

A number of unidentifiable specimens of species of *Bairdia* occur scattered throughout the Cibao and Río Yaque del Norte valleys and the Cordillera Central.

Occurrence.—Río Gurabo: Cercado, Gurabo and Mao formations (Table 2). Río Yaque del Norte (López, Arroyo López): (Table 4). Laguana and Bayaguana amber sites: (Table 5).

Genus **BAIRDOPPILATA**
Coryell, Sample, and Jennings, 1935

Bairdoppilata oblongata (Bold)
Plate 1, figures 16, 17

Bairdia amygdaloides Brady, var. *oblongata* Bold, 1946, p. 70, pl. 1, figs. 5a, b.
Bairdia oblongata Bold. Bold, 1973a, p. 151, table 1; Bold, 1975c, p. 239, pl. 14, fig. 10, pl. 15, figs. 11, 12; Sánchez-Arango, 1977, table 2.
Bairdia aff. *amygdaloides* Brady, var. *oblongata* Bold. Lubimova and Sánchez-Arango, 1974, pl. 3, figs. 1, 1a.

Holotype.—GIRU S 12972.

Type locality.—Loma La Cruz, Santiago de Cuba, Cuba.

Stratigraphic horizon.—La Cruz Formation (Pliocene).

Diagnosis.—An elongate-ovate species of *Bairdoppilata* with strongly-convex dorsal and ventral margins; dorsal margin angled at greatest height and halfway up the posterior slope; anterior end very obliquely-rounded, posterior end somewhat knoblike.

Dimensions.—HVH No. 10497 (left valve), L: 1.05; H: 0.63 (loc. NMB 16970).

Material.—Over 100 specimens.

Occurrence.—Río Cana: Gurabo formation (Table 1). Río Gurabo: Cercado, Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene and Pliocene: Cuba, Dominican Republic.

Genus **PARANESIDEA** Maddocks, 1969

Paranesidea antillea (Bold)
Plate 1, figure 15

Bairdia antillea Bold, 1946, p. 69, pl. 1, figs. 2a–c; Bold, 1965b, p. 387, pl. 1, fig. 13; Bold, 1968, p. 49, pl. 7, figs. 8a, b; Bold, 1972b, p. 424; Bold, 1973a, table 1; Bold, 1975c, p. 138, pl. 15, fig. 1; Sánchez-Arango, 1977, table 2; Bold, 1978b, tables 8, 10.
Bairdia aff. *B. antillea* Bold. Lubimova and Sánchez-Arango, 1974, pl. 6, figs. 1, 1a.

Diagnosis.—A species of *Paranesidea* with rather sharply-pointed extremities; strongly- and regularly-arched dorsal margin, becoming concave near the ends; gently convex ventral margin.

Holotype.—GIRU D 12970.

Type locality.—Loc. W 206, on trail from Victoria de las Tunas to Vásquez, West Oriente Province, Cuba.

Stratigraphic horizon.—Paso Real (= Arabos) Formation (lower Miocene).

Dimensions.—HVH No. 10496 (carapace), L: 0.88; H: 0.53; W: 0.41 (loc. NMB 16993).

Material.—More than 150 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río

Yaque del Norte (López, Arroyo López, Santiago): (Table 4). Laguana amber site: (Table 5).

Distribution.—Lower Miocene to Recent: northern and western Caribbean.

Paranesidea species aff. **P. fortificata** (Brady)

Bairdia sp. aff. *B. fortificata* Brady. Bold, 1968, p. 48, pl. 2, fig. 4; Bold, 1975c, table 2.

Diagnosis.—A strongly-punctate species of *Paranesidea* with large spines at both ends, anterior end only slightly higher than posterior.

Reference material.—HVH No. 8295.

Reference locality.—Loc. H 15242, Río Gurabo, Dominican Republic (Bold, 1968, text-fig. 3).

Stratigraphic horizon.—Gurabo Formation (upper Miocene).

Dimensions.—HVH No. 8295 (left valve), L: 0.83; H: 0.44 (loc. H 15242).

Material.—Two specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene and Pliocene: Cuba, Dominican Republic.

Paranesidea dimorpha (Bold)

Bairdia dimorpha Bold, 1963b, p. 373, pl. 1, figs. 6a–d, table 1; Bold, 1966c, table 1; Bold, 1975c, p. 139, pl. 15, figs. 13, 14 (?16, ?17), table 4; Bold, 1978b, table 2.

Bairdia sp. Bold, 1972a, table 3.

Diagnosis.—An ovate, strongly-punctate species of *Paranesidea*, characterized by a strong angulation of the junction of ventral and anterior margins in the right valve. Slight sexual dimorphism suspected.

Holotype.—USNM 684064.

Type locality.—Loc. R 11863, Melajo River, Trinidad.

Stratigraphic horizon.—Melajo clay member of Springvale Formation (Pliocene).

Dimensions.—HVH No. 10806 (left valve, L: 0.80; H: 0.47 (loc. NMB 16097).

Material.—Fifteen specimens.

Remarks.—These dimensions are similar to those of specimens from the Melajo clay. Specimens from the Manzanilla Formation (Trinidad) are slightly smaller (Bold, 1963b).

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Recent: Trinidad, Colombia, Dominican Republic, Cuba.

Superfamily **CYTHERACEA** Baird, 1850

Family **CYTHERIDEIDAE** Sars, 1925

Subfamily **CYTHERIDEIDINAE** Sars, 1925

Genus **CYPRIDEIS** Jones, 1857

Cyprideis pascagoulaensis (Mincher)
Plate 2, figures 1, 2

Anomocytheridea pascagoulaensis Mincher, 1941, p. 341, pl. 46, figs. 1a–f.

Cyprideis pascagoulaensis (Mincher). Bold, 1976, p. 23, pl. 4, figs. 3–5 (with synonymy); Bold, 1981, p. 103, 105, tables 1, 5, 6, 8–12, 15.

Diagnosis.—Carapace subrectangular to subovate; subdorsal median sulcus; rounded pits, smaller in anterior part of carapace; fairly strong sexual dimorphism; no nodose carapaces observed.

Description.—(see Sandberg, 1964, p. 141).

Holotype.—HVH No. 2071.

Type locality.—Shell Bluff, Chickasawhay River, Mississippi.

Stratigraphic horizon.—Pascagoula Formation, Miocene.

Dimensions.—HVH No. 10499 (left valve, female), L: 0.76; H: 0.48; HVH No. 10499 (right valve, female), L: 0.74; H: 0.43 (loc. NMB 16186).

Material.—More than 150 specimens.

Remarks.—Specimens from the Cercado Formation of the Gurabo and Cana rivers are always pitted. The single specimen from the Arroyo López section (Río Yaque del Norte) is almost smooth, which might be related to higher salinity (see comments on the same phenomenon in *Perissocytheridea cahobensis* Bold, 1981, on p. 14).

Occurrence.—Río Cana: Cercado Formation (Table 1). Río Gurabo: Cercado Formation (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Middle to upper Miocene: Gulf Coast, Caribbean.

Cyprideis species
Plate 2, figures 16–19

Cyprideis aff. *pascagoulaensis* (Mincher). Bold, 1968, table 11.

Diagnosis.—An elongate, subrectangular species of *Cyprideis* with roughly pitted surface and a weak median sulcus. Ends about equal in female, posterior end lower in male.

Reference type.—HVH No. 10738.

Reference locality.—Loc. H 15093, old Santiago–Puerto Plata road, about 6 km northeast of Santiago (Bold, 1968, text-fig. 6).

Stratigraphic horizon.—Mao Formation, according to Bermúdez (1949).

Dimensions.—HVH No. 10738 (carapace, male), L: 1.01; H: 0.55; W: 0.42; HVH No. 10738 (carapace, female), L: 0.94; H: 0.50; W: 0.44 (loc. H 15093).

Material.—Not recovered from NMB localities in the present material.

Remarks.—This species is similar to *Cyprideis* sp. Bold (1975a, pl. 60, figs. 4a, b) from the Jimaní For-

mation of the Enriquillo Basin, but the specimens are poorly preserved and no positive identification can be made. They may be reworked.

Genus **HEMICYPRIDEIS** Malz and Triebel, 1970

Hemicyprideis agoiadiomensis Bold

Cyprideis sp. Bold, 1976, p. 26, pl. 4, fig. 14, text-figs. 11k, l.
Cyprideis aff. *reversa* (Bold). Lubimova and Sánchez-Arango, 1974 (part), pl. 9, figs. 5, 5a [not *Cytheridea* (*Haplocytheridea*) *reversa* Bold, 1946, p. 80, pl. 7, figs. 11a–c, pl. 8, figs. 6a–c].
Hemicyprideis agoiadiomensis Bold, 1981, p. 60, pl. 9, figs. 1–3, tables 2, 13.

Holotype.—HVH No. 10005 (Bold, 1981, pl. 2, fig. 1).
Type locality.—Loc. K 885, Ravine Dondieuque, Haiti (Bold, 1981, text-fig. 6).
Stratigraphic horizon.—Las Cahobas Formation (middle Miocene).
Dimensions.—Carapace, female, L: 0.58; H: 0.33; W: 0.28; carapace, male, L: 0.60; H: 0.32; W: 0.25 (Laguana amber site, No. 8).
Material.—Three specimens.
Occurrence.—Laguana amber site: (Table 5).
Distribution.—Middle Miocene: Cuba and Hispaniola.

Hemicyprideis cubensis cubensis (Bold)

Cytheridea (*Haplocytheridea*) *cubensis* Bold, 1946, p. 79, pl. 7, figs. 8a–e.
Hemicyprideis cubensis cubensis (Bold). Bold, 1976, p. 29 (with synonymy); Sánchez-Arango, 1977, table 2; Bold, 1981, pl. 18, tables 2, 3, 9.

Holotype.—GIRU S 12994.
Type locality.—Loc. W 206, West Oriente Province, Cuba (Bold, 1946, p. 127; Bold, 1973a, p. 143).
Stratigraphic horizon.—Paso Real Formation (lower Miocene).
Dimensions.—Carapace, L: 0.64; H: 0.32; W: 0.28 (Laguana amber site, No. 9).
Material.—One specimen.
Occurrence.—Laguana amber site: (Table 5).
Distribution.—Lower to upper Miocene: Greater Antilles, northern Lesser Antilles, and Central America.

Hemicyprideis stephensoni (Bold)

Cytheridea (*Haplocytheridea*) *stephensoni* Bold, 1946, p. 79, pl. 7, figs. 5a–f.
Hemicyprideis stephensoni (Bold). Bold, 1976, p. 29 (with synonymy); Sánchez-Arango, 1977, table 2; Furrazola Bermúdez *et al.*, 1978, p. 40; Bold, 1981, p. 14, tables 2, 3.

Holotype.—GIRU S 12993.
Type locality.—Loc. W 206, West Oriente Province, Cuba (Bold, 1946, p. 127; Bold, 1973a, p. 148).
Stratigraphic horizon.—Paso Real Formation (lower Miocene).
Dimensions.—HVH No. 10807 (carapace, female), L: 0.75; H: 0.43; W: 0.35; HVH No. 10807 (carapace, male), L: 0.76; H: 0.43; W: 0.32 (Bayaguana amber site).
Material.—Fifty-six specimens.
Occurrence.—Bayaguana amber site: (Table 5).
Distribution.—Lower to middle Miocene: Greater Antilles, northern Lesser Antilles, and Central America.

Subfamily **KRITHINAE** Mandelstam, 1958

Genus **KRITHE**
Brady, Crosskey, and Robertson, 1874

Krithe dolichodeira Bold

Krithe dolichodeira Bold, 1946, p. 75, pl. 4, figs. 14a–b; Bold, 1981, p. 68, pl. 1, fig. 12 (with synonymy).

Holotype.—GIRU S 12986.
Type locality.—Loc. T 1439, Nipe Basin, Cuba (Bold, 1973a, p. 148).
Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (Júcaro Formation of Kozary, 1957, Jakus, 1983, p. 62).
Dimensions.—See Text-figure 6.
Material.—More than 300 specimens.
Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).
Distribution.—Upper middle Miocene to Recent: Caribbean.

Krithe lambi Bold

Krithe lambi Bold, 1966a, p. 180, pl. 22, figs. 1a–c, text-fig. 1; Bold, 1981, p. 67, pl. 1, fig. 11 (with synonymy).

Holotype.—HVH No. 7883.
Type locality.—Loc. RM 19391, Pozón–El Mene road, Falcón, Venezuela.
Stratigraphic horizon.—Husito clay of Pozón Formation (middle Miocene).
Dimensions.—Left valve, L: 0.53; H: 0.27 (loc. NMB 16093, No. 17).
Material.—Sixteen specimens.
Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).
Distribution.—Lower Miocene to Pliocene: Caribbean.

Krithe prolixa Bold

Krithe prolixa Bold, 1966a, p. 180; Bold, 1978b, table 4; Bold, 1981, p. 68 (with synonymy), tables 3, 4, 8, 13; Steineck, 1981, p. 347, pl. 1, fig. 13, table 2; Steineck *et al.*, 1984, figs. 8j, 14, 15.

Holotype.—USNM 563501 (as *Krithe elongata* Bold, 1960, p. 3, figs. 5a, b).

Type locality.—Loc. Wirz 214, between Princess Town and Río Claro, Trinidad.

Stratigraphic horizon.—Cipero Formation, *Globorotalia fohsi robusta* Zone, middle Miocene.

Dimensions.—HVH No. 10508 (left valve), L: 0.78; H: 0.38 (loc. H 15101).

Material.—One specimen.

Occurrence.—Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Oligocene to Recent: Caribbean.

Krithe trinidadensis Bold

Krithe trinidadensis Bold, 1958, p. 398, pl. 1, figs. 3a–f; Sanguinetti, 1979, p. 132, pl. 4, figs. 2a, b, pl. 10, figs. 4a, b; Bold, 1981, p. 69 (with synonymy), tables 4, 8, 13, 14; Steineck, 1981, p. 347, pl. 2, figs. 9–11; Steineck *et al.*, 1984, figs. 9B, L, 14, 15.
Krithe aff. *trinidadensis* Bold. Breman, 1982, pl. 1, fig. 4e.

Holotype.—USNM 562059 (Bold, 1958, pl. 1, fig. 4e).

Type locality.—Loc. Favre 56a, 4.2 mi east of Rio Claro, Trinidad.

Stratigraphic horizon.—Cipero Formation, *Globorotalia fohsi lobata* Zone, middle Miocene.

Dimensions.—Left valve, L: 1.00; H: 0.54 (loc. NMB 17196, No. 1).

Material.—One specimen.

Occurrence.—Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Oligocene to Recent: Caribbean.

Genus **PARAKRITHE** Bold, 1958

Parakrithe alta, new species
Plate 2, figures 3, 4, Text-figures 7a, b

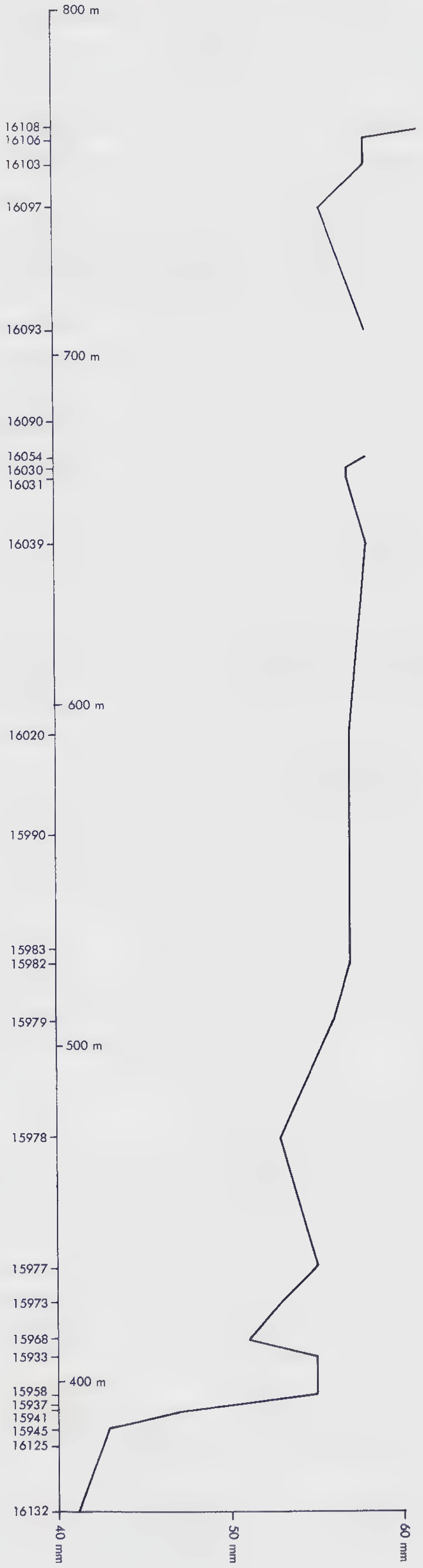
Parakrithe sp. Bold, 1966c, table 1; Bold, 1972a, table 2 (part); Howe and Bold, 1975, p. 308; Bold, 1978b, table 9.
Parakrithe vermunti (Bold). Bold, 1968, table 7 [not *Cytheridea* (*Dolocytheridea*) *vermunti* Bold, 1946, p. 83, pl. 7, figs. 12 a–d].
Parakrithe sp. 1. Bold, 1971b, pl. 2, fig. 1, pl. 5, figs. 3a–c [not pl. 3, fig. 5].

Etymology of name.—(L) *altum* = high [because of the relatively large ratio of height to length].

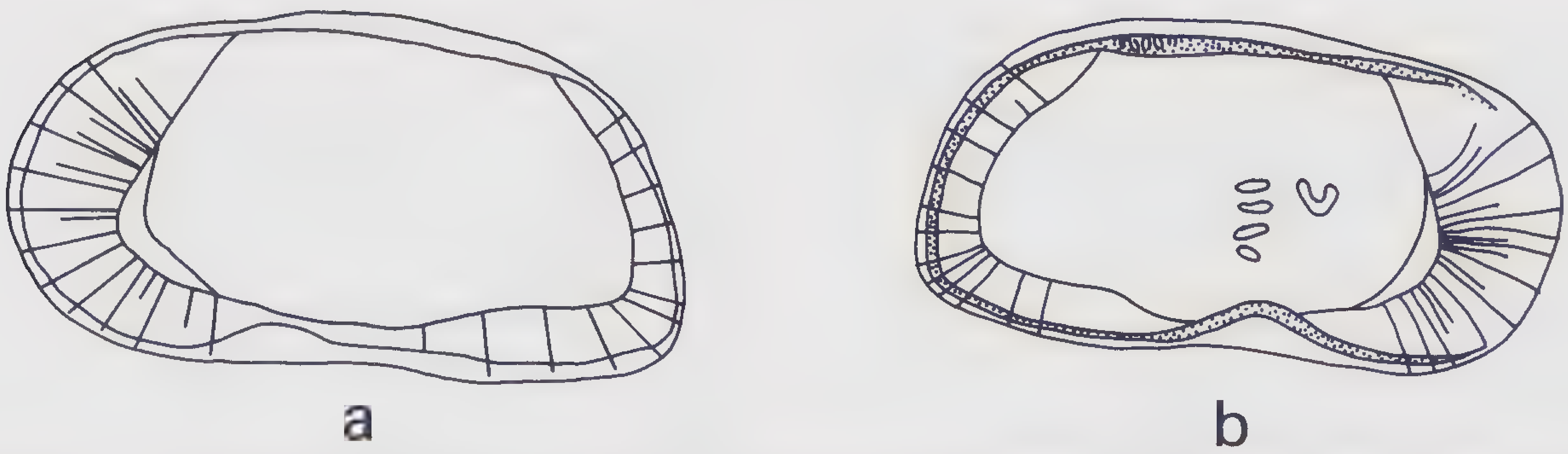
Diagnosis.—A species of *Parakrithe* with a relatively large height : length ratio (> 0.6), and steeply-truncate posterior end.

Holotype.—HVH No. 10500 (left valve, female).

Paratypes.—HVH No. 10501 (right valve, female), HVH No. 10502 (right valve, female; left valve, female; left valve, male), HVH No. 10503 (two left valves, female; one right valve, female).



Text-figure 6.—Distribution of greatest length of specimens of *Krithe dolichodeira* in NMB samples from the Río Gurabo section. Only the length of the largest specimen in each sample is plotted to avoid the confusion of possible down-slope contamination by smaller specimens.



Text-figure 7.—*Parakrithe alta,* n. sp., HVH No. 10502, loc. NMB 16106, Mao Formation, Río Gurabo section. a: interior of right valve, ×145; b: interior of left valve, ×145.

Type locality.—Loc. NMB 16108, Río Gurabo section.

Stratigraphic horizon.—Lower Mao Formation (Pliocene).

Description.—Carapace short, rectangular, greatest height in posterior half. Anterior margin regularly-rounded, dorsal margin slightly sinuate, almost parallel to the sinuous ventral margin; posterior margin curved down steeply, almost vertically truncate at mid-height of the left valve, more gently curved in the right valve. Dorsal view somewhat drop-shaped, greatest width in the posterior half; anterior end attenuated, posterior end less acute. Left valve larger than the right, strongest overlap posterodorsally. Female higher and wider than the more elongate males.

Hinge pseudoadont, with slight crenulation in the posterior part of the bar in the right valve. Marginal area very wide anteriorly, with a small triangular vestibule. Marginal pore canals long and slender, about 12 in the anterior end; fewer false radial canals (seven to nine). Selvage strongly curved inside just in front of the middle of the ventral margin. Adductor scars a vertical row of four individual scars, slightly elongate, except for the lower one. Frontal scar variable in detail, but always U-shaped.

Dimensions.—HVH No. 10500 (left valve, female), L: 0.43; H: 0.23 (loc. NMB 16108); HVH No. 10501 (right valve, female), L: 0.43; H: 0.21 (loc. NMB 16108); HVH No. 10502 (right valve, male), L: 0.45; H: 0.23 (loc. NMB 16106); HVH No. 10502 (left valve, male), L: 0.39; H: 0.21 (loc. NMB 16106).

Remarks.—The species differs from *P. vermunti* by its greater height and from *Parakrithe rhamphodes* Bold, 1966c (p. 19, pl. 1, figs. 4a–d, pl. 5, fig. 1) by its blunter posterior end.

Material.—More than 30 specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Pliocene: Cuba, Jamaica, Hispaniola, Mexico, Venezuela.

Genus **PSEUDOPSAMMOCYTHERE**
Carbonnel, 1966

Pseudopsammocythere ex gr. **vicksburgensis**
(Howe and Law)
Plate 2, figures 5–7, Text-figure 8

Krithe vicksburgensis Howe and Law, 1936, p. 75, pl. 6, figs. 12, 13.
Paracyprideis vicksburgensis (Howe and Law). Bold, 1946, p. 78, pl. 7, fig. 4; Bold, 1950, p. 82.
Parakrithella sp. Bold, 1963b, p. 378, pl. 4, fig. 4; Bold, 1966c, table 2, p. 15; Bold, 1968, tables 7, 9; Bold, 1973a, table 1; Bold, 1975a, p. 589, pl. 59, figs. 4a, b.
Pseudopsammocythere sp. Bold, 1975c, tables 2, 4; Bold, 1981, p. 107.
Psammocythere vicksburgensis (Howe and Law). Hazel, Mumma, and Huff, 1980, p. 382, pl. 1, fig. 1.

Holotype.—HVH No. 1764.

Type locality.—West bank of Pearl River at Byram, Mississippi.

Stratigraphic horizon.—Byram marl, Oligocene.

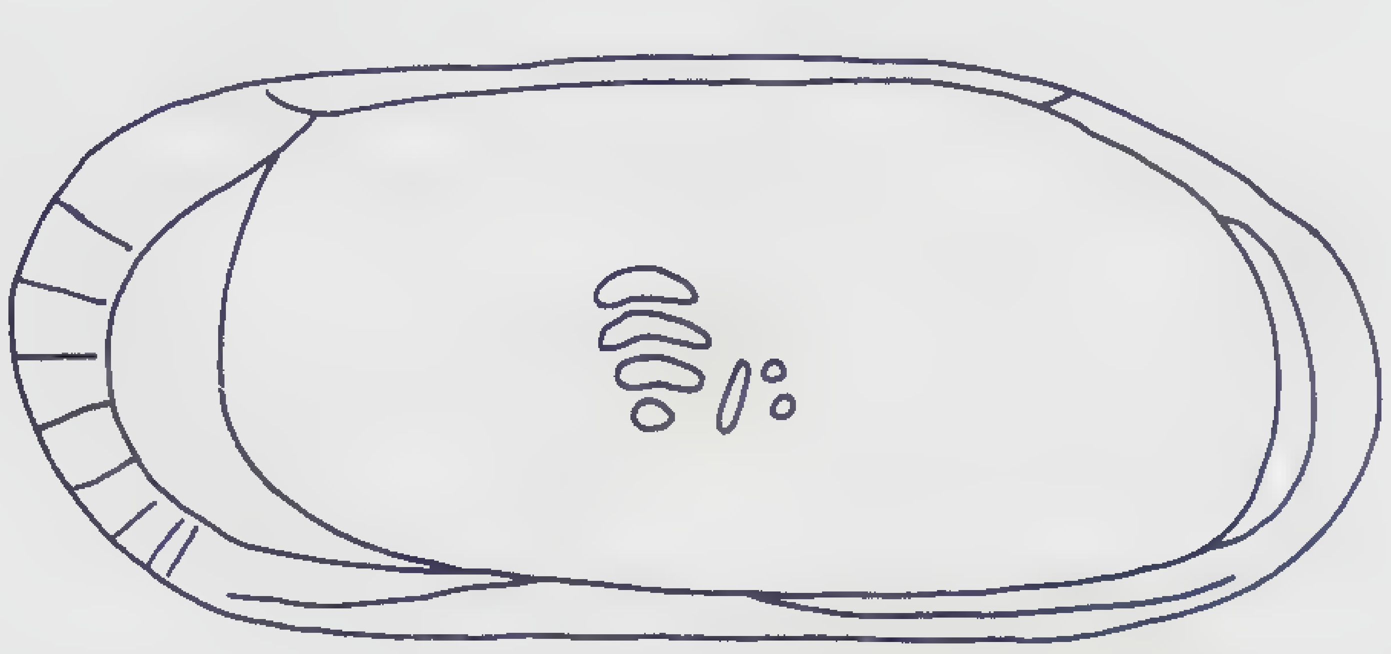
Reference material.—HVH No. 6861.

Reference locality.—Melajo River, Trinidad.

Stratigraphic horizon.—Melajo clay member of Springvale Formation, Pliocene.

Dimensions.—HVH No. 10506 (left valve), L: 0.45; H: 0.20; HVH No. 10504 (carapace), L: 0.45; H: 0.20; W: 0.15 (loc. NMB 16145).

Remarks.—This form is very close to *Krithe vicksburgensis,* but the carapace is a little more slender.



Text-figure 8.—*Pseudopsammocythere* ex gr. *vicksburgensis* (Howe and Law), interior of right valve, HVH 10507, loc. NMB 16097. Note the presence of additional scars behind the row of adductor muscle scars.

However, there is so little difference between Oligocene, Miocene, Pliocene and Recent material, that I prefer to include them all in the same group. This group differs from a similar group of species, *Pseudopsammocythere peterseni* (Teeter, 1980) [= *Parakrithella hanaii* Teeter, 1975, p. 432, figs. 6h, 7c–e (not *Parakrithella hanai* Hartmann, 1962, p. 190); *Parakrithella peterseni* Teeter, 1980, p. 547], which group appears to be restricted to the Central American Province.

Material.—About 140 specimens.

Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4). Bayaguana and Laguana amber sites: (Table 5).

Distribution.—Oligocene to Recent: Mexican and United States Gulf Coast, Cuba, Hispaniola, Trinidad.

Subfamily NEOCYTHERIDEIDINAE Puri, 1957

Genus CUSHMANIDEA Blake, 1933

Cushmanidea species
Plate 3, figures 1, 2

Cushmanidea anderseni (Puri)? Bold, 1968, p. 53, pl. 4, fig. 10.
Not *Cytherideis anderseni* Puri, 1952b, p. 908, pl. 130, figs. 15–17 (not text-figs. 9, 10).

Remarks.—This species differs from *C. anderseni* by its finely punctate, smaller carapace which has the greatest height more anteriorly. *C. cristifera* Teeter, 1975 (p. 429, figs. 5n, o, 6f, 7a) is more elongate and smooth.

Dimensions.—HVH No. 10516 (left valve), L: 0.48; H: 0.28 (loc. NMB 16176); HVH No. 10515 (right valve), L: 0.48; H: 0.28 (loc. NMB 16156).

Material.—Twelve specimens.

Occurrence.—Río Cana: Cercado, Gurabo, and Mao formations (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Cushmanidea howei (Bold)

Cytherideis howei Bold, 1946, p. 88, pl. 7, figs. 9a–c.
Cushmanidea howei (Bold). Bold, 1965b, p. 392, pl. 2, fig. 4; Kusnetzov *et al.,* 1977, p. 52; Bold, 1981, p. 70 (with synonymy), pl. 1, fig. 8, table 3; Bold, 1982, tables 2–4.

Holotype.—GIRU S 13009.

Type locality.—Loc. W 206, West Oriente Province, Cuba (Bold, 1946, p. 127; Bold, 1973a, p. 148).

Stratigraphic horizon.—Paso Real Formation (lower Miocene).

Dimensions.—Carapace, L: 0.98; H: 0.45 (Laguana amber site, No. 7).

Material.—Six specimens.

Occurrence.—Laguana and Bayaguana amber sites: (Table 5).

Distribution.—Upper Oligocene to lower middle Miocene: Caribbean.

Family CYTHERIDAE Baird, 1850

Subfamily PERISSOCYTHERIDEINAE Bold, 1963b

Genus PERISSOCYTHERIDEA Stephenson, 1938

Perissocytheridea alata Bold

Perissocytheridea alata Bold, 1946, p. 84, pl. 14, figs. 4a–c; Sánchez-Arango, 1977, table 2; Bold, 1981, p. 76 (with synonymy), pl. 6, figs. 7a–c, tables 2, 3.

Holotype.—GIRU S 13002.

Type locality.—Loc. W 206, West Oriente Province, Cuba (Bold, 1946, p. 127; Bold, 1973a, p. 148).

Stratigraphic horizon.—Paso Real Formation, lower Miocene.

Dimensions.—Right valve, L: 0.32; H: 0.19 (Laguana amber site, No. 21).

Material.—Eight specimens.

Occurrence.—Laguana amber site: (Table 5).

Distribution.—Lower to middle Miocene: Greater Antilles, northern Lesser Antilles, and Panama.

Perissocytheridea cahobensis Bold
Plate 2, figures 10–13

Perissocytheridea cahobensis Bold, 1981, p. 73, pl. 6, figs. 4, 5.
Perissocytheridea compressa Bold. Bold, 1983, p. 415, fig. 9 [not *P. compressa* Bold, 1975c].

Holotype.—HVH No. 10015.

Type locality.—Loc. M 1182, Rivière Grande, Haiti (Bold, 1981, text-fig. 9).

Stratigraphic horizon.—Lower part of the Las Cahobas Formation (upper Miocene).

Dimensions.—Females, L: 0.45–0.48; H: 0.29–0.30; males, L: 0.52–0.54; H: 0.30–0.32*; HVH No. 10509 (male), L: 0.53; H: 0.30; W: 0.32 (loc. NMB 16205).

Material.—More than 100 specimens.

Remarks.—The degree of ornamentation is quite variable. Some specimens (especially from the Arroyo López section) are smooth and shiny, others are slightly punctate, but in some cases fairly strong reticulation may occur (Cercado Formation, Río Gurabo). The same kind of variation was found in Haiti in the Las Cahobas Formation. There appears to be a slight tendency towards stronger reticulation in specimens higher up in the section, and these may resemble *P. compressa* Bold, 1975c (p. 143, pl. 16, figs. 7–10) from the La Cruz marl (Pliocene) of Cuba. However, they can always be differentiated from that species by their posteroventral notch.

In a study on the variability of punctation of valves in a species of *Cyprideis* from the Lake of Tunis, Car-

* Based on measurements of obvious largest and smallest forms. Sample size unknown.

bonel and Pujos (1982) reported that coarse punctation corresponds to a high ionic ratio of Mg^{++}/Ca^{++} of the environment, whereas smooth valves occur in an environment with low Mg^{++}/Ca^{++} ratio. Chivas, DeDecker, and Shelley (1983) have pointed out that the Mg/Ca ratio in the ostracode shell increases with temperature. This would agree with Carbonnel's (1975) observations on temperature changes influencing the "facteur lisse". In the Cercado Formation, the reticulate forms of *Perissocytheridea cahobensis* are not associated with marine forms (Tables 1, 2), whereas the smooth forms predominate in the upper brackish-water intercalation in the Río Cana (Table 1), where they are associated with marine forms. The same phenomenon is observed in the Arroyo López section (Table 4).

Occurrence.—Río Cana: Cercado Formation (Table 1). Río Gurabo: Cercado Formation (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene, Hispaniola.

Perissocytheridea pumila Bold
Plate 2, figure 14

Perissocytheridea pumila Bold, 1975c, p. 142, pl. 19, figs. 3–7.

Diagnosis.—Small species of *Perissocytheridea* with ornamentation of high ridges in a reticulate pattern.

Holotype.—HVH No. 9157.

Type locality.—Water well in Escuela de Medicina, Universidad de Oriente, Santiago de Cuba, Cuba.

Stratigraphic horizon.—Santiago Formation of Franco*.

Dimensions.—HVH No. 10512 (right valve, female), L: 0.43; H: 0.29 (loc. NMB 16205).

Material.—Two specimens.

Occurrence.—Río Gurabo: Cercado Formation (Table 4).

Distribution.—Upper Miocene to Pliocene: Cuba, Dominican Republic.

Perissocytheridea species

Remarks.—Rare specimens of perhaps more than one species are found in the Mao Formation of the Río Gurabo section (Table 2); they are badly preserved and may be reworked. Very similar specimens have been found in the Cercado Formation of the Río Cana section (Table 1). Some appear similar to *P.* sp. B of Bold, 1975a (p. 611, pl. 59, figs. 13a–c) from the Las Salinas and Jimaní formations of southern Hispaniola (Pliocene–?Pleistocene). Other, different specimens occur in the Río Yaque del Norte (Arroyo López): (Table 4).

Dimensions.—Left valve (female), L: 0.45; H: 0.28 (loc. NMB 16097, No. 15); left valve (male), L: 0.45; H: 0.27 (loc. NMB 16054, No. 11).

Material.—Eleven specimens.

Genus **PUMILOCYTHERIDEA** Bold, 1963b

Pumilocytheridea sandbergi Bold
Plate 2, figure 15

Pumilocytheridea sandbergi Bold, 1963b, p. 382, pl. 4, figs. 3a–d, pl. 12, figs. 1a–d, 2a, b; Bold, 1964, pls. 8, 11, table 2; Bold, 1966c, pp. 10, 15; Bold, 1966d, p. 23, pl. 2, figs. 6a–d; Baker and Hulings, 1966, p. 114, pl. 1, figs. 2a, b; Bold, 1972a, table 1; Bold, 1973b, p. 344; Bold, 1975a, table 7; Bold, 1975c, table 5; Bold, 1975d, table 1; Teeter, 1975, p. 434, figs. 7l, m; Bold, 1978b, table 9.

Holotype.—USNM 684071.

Type locality.—Loc. R 11862, Melajo River, northern Trinidad.

Stratigraphic horizon.—Melajo clay member of Springvale Formation (Pliocene).

Dimensions.—HVH 10514 (left valve), L: 0.38: H: 0.16 (loc. NMB 16978).

Material.—About 40 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene to Recent: Caribbean.

Genus **GANGAMOCYTHERIDEA** Bold, 1963b

Gangamocytheridea? plicata Bold
Plate 2, figures 8, 9

Gangamocytheridea? plicata Bold, 1968, p. 53, pl. 7, figs. 4a–c, pl. 9, fig. 5; Bold, 1971b, table 5; Bold, 1975a, tables 10, 15; Bold, 1978b, table 9.

Diagnosis.—A species of *Gangamocytheridea*? with plications instead of the normal reticulation.

Holotype.—HVH No. 8329.

Type locality.—Loc. H 15212, Bluff 1 of Maury (1917) on Río Mao (Bold, 1968, text-fig. 4); Dominican Republic.

Stratigraphic horizon.—Gurabo Formation (upper Miocene).

Dimensions.—HVH No. 10513 (left valve), L: 0.38; H: 0.22 (loc. NMB 16125).

Material.—More than 70 specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Upper Miocene to Recent: Jamaica, Hispaniola, Costa Rica, Mexico.

* According to Jakus (1983, p. 77), the Santiago Formation was described by G. L. Franco in Nagy, E., *et al.,* 1976 [not seen]. Jakus includes references to Nagy *et al.,* 1975. [MS] *Nuevos datos sobre posibilidades de acumulaciones industriales de bauxitas en Cuba.* Arch. Inst. Geol. Paleontol., Acad. Cienc., Cuba, and to Nagy, E., and Coutin, P. D., 1976. *Rocas diatomíticas en Oriente.* Inst. Geol. Paleontol., Acad. Cienc., Cuba, No. 25, pp. 9–11. The former paper does not appear to have been published, and no reference to the Santiago Formation is made in the latter paper.

Subfamily **PECTOCYTHERINAE** Hanai, 1957

Genus **MUNSEYELLA** Bold, 1957a

Munseyella jungi, new species
Plate 3, figures 3–5

Munseyella bollii Bold. Bold, 1968, table 7 [not *Munseyella bollii* Bold, 1966d, p. 21, pl. 2, figs. 2a, b].
Munseyella sp. 2. Saunders, Jung, and Biju-Duval, 1986, table 2.

Etymology of name.—In honor of Peter Jung, Natural History Museum, Basel, Switzerland.

Diagnosis.—A species of *Munseyella* with weak surface ornamentation: some pits in the posterodorsal portion of the carapace and five to six rather wide fossae just behind the anterior rim. Posteroventral portion strongly compressed behind the end of a ridge-like swelling in the median part of the valve.

Holotype.—HVH No. 10517 (right valve).

Paratypes.—HVH No. 10518 (carapace, left valve), HVH No. 10519 (right valve), HVH No. 10520 (left valve).

Type locality.—Loc. NMB 16148, Río Gurabo section.

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace small, elongate rectangular, highest at two-sevenths of the length from the anterior extremity, widest at two-sevenths of the length from the posterior extremity. Anterior end evenly rounded, rimmed, with a slight depression just in front of the greatest height, where the margin is slightly concave over a short distance; dorsal margin gently convex, ventral margin slightly sinuate with a concavity almost in the middle of the margin. Dorsal and ventral margins converge very slightly posteriorly. Posterior end truncate with two rounded tubercles in each valve. Valves strongly compressed posteroventrally.

Ornamentation consists of an anterior rim, which somewhat deviates mid-anteriorly from the outer margin; in the space between outer margin and rim some very small tubercles occur, about nine of which are located in the slight concavities created by the somewhat sinuate (dentate) shape of the rim. Behind the rim six to seven rather large fossae occur; the interior of the fossae is finely punctate. The rest of the valve is almost smooth, except for a number of fairly large pits in the mid- and posterodorsal portion.

Hinge pentodont, typical for the genus; median hinge-element crenulate. In the posterior end the selvage runs down almost vertically from the posterior hinge-element. Marginal area very wide anteriorly with a wide vestibule. Details are difficult to make out because the inner lamella was broken in all available single valves. Adductor muscle scars form a vertical row of four with the two lower ones almost merging; frontal scar U-shaped, located in front of the two middle adductor scars. Between these three scars lies a fulcral point. A single mandibular scar lies vertically below this. Normal pore canals are few, widely scattered, mostly located on pore papillae.

Dimensions.—HVH No. 10518 (carapace, male), L: 0.31; H: 0.16; W: 0.11 (loc. NMB 16145); HVH No. 10517 (right valve, female, holotype), L: 0.33; H: 0.18 (loc. NMB 16148); HVH No. 10518 (left valve, male), L: 0.32; H: 0.17 (loc. NMB 16145); HVH No. 10519 (right valve, female), L: 0.32; H: 0.18 (loc. NMB 16156).

Material.—More than 30 specimens.

Remarks.—*Munseyella bollii,* with which this species was originally confused, has a heavier and more regularly-rounded anterior rim, and is not so strongly compressed posteroventrally.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Munseyella saundersi, new species
Plate 4, figures 8–14

Munseyella sp. Bold, 1981, p. 71, pl. 5, fig. 12, tables 14, 15.
Munseyella sp. 1. Saunders, Jung, and Biju-Duval, 1986, table 2.

Etymology of name.—In honor of J. B. Saunders, Natural History Museum, Basel, Switzerland.

Diagnosis.—A species of *Munseyella* with a continuous ridge from the anterior rim, along the dorsal margin to the posterior rim; V-shaped posterodorsal ridge; depressed posteroventral area.

Holotype.—HVH No. 10521 (carapace, female).

Paratypes.—HVH No. 10520 (left valve, female), HVH No. 10522 (carapace, female), HVH No. 10523 (left valve, male), HVH No. 10524 (right valve, male), HVH No. 10525 (left valve, female), HVH No. 10526 (right valve, female).

Type locality.—Loc. NMB 160639, Río Gurabo section.

Stratigraphic horizon.—Mao Formation (Pliocene).

Description.—Carapace elongate subrectangular to subtriangular, highest at the anterior cardinal angle, close to the anterior extremity. Sexually dimorphic: dimensions of males and females are similar, but the males are vertically compressed in the posterior part. Anterior end blunt, anterior margin regularly rounded with a heavy rim, which continues along the dorsum and which bears a few short, blunt spines; dorsal margin almost straight, very slightly convex in the left valve, straight in the right; ventral margin almost straight, converging gently towards the dorsal posteriorly, more strongly in the male; posterior end steeply, almost vertically, truncate with two short, blunt spines: the lower one located near the posteroventral corner, where the dorsal ridge, continuing downward as a posterior rim, meets the ventral margin; in the left valve this ridge makes a more regular curve than in the right one. A broad ridge runs from near the ventral margin

at one-third of the length from the posterior extremity, obliquely forward and upward in the direction of the middle of the anterior margin. The valves are laterally compressed behind and above this ridge, forming a depressed area that is bordered dorsally by a broad, V-shaped, posterodorsal ridge and on the posterodorsal side by the posterior rim.

Interior typical for the genus. Marginal area with a wide loop of the line of concrescence in the anterior end. Hinge pentodont.

Dimensions.—HVH No. 10520 (left valve, female), L: 0.27; W: 0.14 (loc. NMB 15982); HVH No. 10521 (carapace, female, holotype), L: 0.30; H: 0.17; W: 0.11 (loc. NMB 16039); HVH No. 10522 (carapace, female), L: 0.29; H: 0.16; W: 0.11 (loc. NMB 16039); HVH No. 10523 (left valve, male), L: 0.28; H: 0.16 (loc. NMB 15982); HVH No. 10524 (right valve, male), L: 0.30; H: 0.15 (loc. NMB 16030); HVH No. 10525 (left valve, female), L: 0.27; H: 0.15 (loc. NMB 16090); HVH No. 10526 (right valve, female), L: 0.30; H: 0.16 (loc. NMB 16039); HVH No. 10527 (left valve, female), L: 0.31; H: 0.17 (St. Marc #1 borehole, Haiti).

Material.—Seventy-four specimens.

Remarks.—This species could be confused with the somewhat larger *M. bermudezi* Bold, 1966d (p. 22, pl. 2, figs. 1a, b), but differs by its V-shaped posterodorsal ridge.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Pliocene: Hispaniola.

Munseyella, new species
Plate 4, figure 15

Diagnosis.—A small species of *Munseyella,* elongate-rectangular in shape, distinguished by a straight dorsal ridge from the anterior cardinal angle to below the posterior cardinal angle, diverging from the dorsal margin, continuing posteriorly in a curve, more or less parallel to the posterior margin, and breaking up in a series of short, *en-echelon* ridges, parallel to the ventral margin.

Dimensions.—HVH No. 10736 (carapace), L: 0.34; H: 0.16; W: 0.13 (loc. NMB 17189).

Material.—One specimen.

Occurrence.—Loc. NMB 17189, Río Yaque del Norte (López): (Table 4).

Subfamily **CYTHEROMORPHINAE**
Mandelstam, 1960

Genus **HEINIA** Bold, 1985

Heinia species aff. **H. howei** Bold
Plate 3, figure 6

Heinia sp. aff. *H. howei* Bold, 1985, p. 6, pl. 1, figs. 6.6, 6.8.

Reference material.—HVH No. 9544.

Reference locality.—Loc. NMB 16039, Río Gurabo.

Stratigraphic horizon.—Mao Formation (Pliocene).

Dimensions.—HVH No. 9544 (left valve), L: 0.26; H: 0.13 (loc. NMB 16039).

Material.—Six specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Pliocene: Dominican Republic, Costa Rica.

Family **TRACHYLEBERIDIDAE**
Sylvester-Bradley, 1948

Subfamily **HEMICYTHERINAE** Puri, 1953a

Genus **RADIMELLA** Pokorný, 1969

Radimella confragosa (Edwards)
Plate 4, figure 1

Hemicythere confragosa Edwards, 1944, p. 518, pl. 86, figs. 23–26.
Mutilus confragosus (Edwards). Bold, 1968, tables 4–13, 15 (part).
Radimella confragosa (Edwards). Bold, 1975b, p. 697, pl. 1, figs. 1–4, 16, 17, text-figs. 3a, b (with synonymy); Bold, 1975c, p. 145, pl. 17, fig. 1; Bold, 1975d, table 1; Benson, 1976, pp. 40–52; Hazel, 1977, fig. 6a; Furrazola Bermúdez *et al.,* 1978, p. 40 (table); Bold, 1981, table 15; Bate, Whittaker, and Mayes, 1981, p. 24, figs. 16F, G; Bold, 1983, fig. 1.
Radimella ex gr. *confragosa* (Edwards). Bold, 1978b, tables 1, 8, 9 (part).

Diagnosis.—A species of *Radimella* with pronounced anterior cardinal angle, slightly bent dorsal margin; dorsal ridge flush with posterodorsal margin. Fossae of unequal size. Dorsal ridge system pronounced and sloping rather steeply forward.

Holotype.—USNM 559423.

Type locality.—Pit on west side of US Highway 74, north side of Lumber River near Lumberton, North Carolina.

Stratigraphic horizon.—Duplin marl (Pliocene).

Dimensions.—HVH No. 10534 (left valve), L: 0.67; H: 0.42 (loc. NMB 17011).

Material.—Over 600 specimens.

Occurrence.—Río Cana: Cercado, Gurabo and Mao formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).

Distribution.—Upper Miocene to Pleistocene (?Recent): U. S. Atlantic and Gulf Coasts, Mexico, Costa Rica, Colombia, Venezuela, Trinidad, Greater Antilles.

Radimella confragosa (Edwards) form A
Plate 4, figure 2

Mutilus confragosus (Edwards). Bold, 1968, tables 4–10 (part).
Radimella confragosa (Edwards) form A. Bold, 1975b, p. 697 (with synonymy), pl. 1, figs. 8, 9 [not fig. 10 = *Radimella ovata,* n. sp.]; Bold, 1975c, p. 146, table 4; Bold, 1981, tables 12, 15.

Diagnosis.—A species of *Radimella* in which the dorsal ridge diverges posteriorly from the posterodorsal margin and projects over it; dorsal margin strongly bent, anterior cardinal angle strongly pronounced.

Reference material.—HVH No. 9100.

Reference locality.—Loc. PR 3, Ponce Cement Quarry, Puerto Rico (Bold, 1969, p. 118).

Stratigraphic horizon.—Ponce Formation *s. s.* (Pliocene).

Dimensions.—HVH No. 10535 (left valve), L: 0.68; H: 0.40 (loc. NMB 16180).

Material.—Over 80 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Cercado, Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene to Recent: Greater Antilles.

Radimella ovata, new species
Plate 4, figures 3–5

Mutilus confragosus (Edwards). Bold, 1968, tables 4–7, 9, 10 (part).
Radimella sp. 1. Bold, 1975b, p. 698, pl. 1, figs. 11, 13, 14 (with synonymy).
Radimella confragosa (Edwards) form A. Bold, 1975b, pl. 1, fig. 10.
Radimella ex gr. *confragosa* (Edwards). Bold, 1978b, table 9 (part).

Diagnosis.—A species of *Radimella* with subdued anterior cardinal angle, convex dorsal margin, dorsal ridge parallel to and below the posterodorsal margin; fossae of about equal size throughout; posterodorsal area of the reticulum wide.

Holotype.—HVH No. 9102 (left valve) (Bold, 1975b, pl. 1, fig. 11).

Paratype.—HVH No. 10538 (two carapaces), HVH No. 10539 (left valve).

Type locality.—Loc. Rutsch 124, Savaneta River near Gran Couva, Trinidad.

Stratigraphic horizon.—Savaneta glauconitic clay member of the Springvale Formation (lower Pliocene).

Description.—Carapace ovate to subquadrangular in side view, highest at anterior cardinal angle at one-third of the length from the anterior extremity. Anterior margin obliquely-rounded, dorsal margin gently convex, ventral margin convex, posterior end angled subventrally with a steep and concave posterior margin in the dorsal part; posterior cardinal angle obtuse but well marked. Ornamentation with the reticulate pattern typical of *Radimella*. Among the ridges the following are more pronounced: anterior rim, ventrally parallel to the anterior margin, diverging slightly upwards and including the small eye-tubercle; just beyond the eye-spot it becomes parallel to the dorsal margin to just below the posterior cardinal angle, then turns sharply down and continues straight in the direction of the posteroventral angle; ventral ridge almost straight from the ventral part of the anterior ridge backward, reaching the ventral margin at a point one-third of the length from the posterior end; posterodorsal ridge curved, well below the dorsal margin; four median, longitudinal ridges are bunched together in the center of the valves; the third from above curves upward in the direction of the posterior cardinal angle and forms with the oblique posterior ridge a wide V in which the posterodorsal group of meshes is located.

Interior typical for the *Radimella* group.

Dimensions.—HVH No. 9103 (left valve), L: 0.58; H: 0.37 (Cubagua #2, core 10, Venezuela); HVH No. 9102 (left valve, holotype), L: 0.63; H: 0.43 (loc. Rutsch 124, Trinidad); HVH No. 10536 (right valve), L: 0.61; H: 0.39 (loc. NMB 16156); HVH No. 10537 (left valve), L: 0.63; H: 0.38 (loc. NMB 16156); HVH No. 9097 (left valve), L: 0.63; H: 0.44 (loc. H 15211).

Material.—About 40 specimens.

Remarks.—This species shows similarity to species of the genus *Malzella* Hazel, 1983 by its subdued anterior cardinal angle and curved dorsal margin.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to lower Pliocene: Hispaniola, Trinidad, Venezuela, Costa Rica.

Genus **PROCYTHEREIS** Skogsberg, 1928

Procythereis? **deformis** (Reuss)

Cypridina deformis Reuss, 1850, p. 69, pl. 9, figs. 25a, b.
Cythere deformis (Reuss). Bosquet, 1852, p. 82, pl. 4, fig. 4.
Brachycythere deformis (Reuss). Bold, 1946, p. 107, pl. 13, figs. 2a–d.
Hemicythere deformis (Reuss). Keij, 1957, p. 123, pl. 18, figs. 5–7.
Aurila deformis (Reuss). Bold, 1957b, p. 239 (part, not pl. 1, fig. 8).
Procythereis? *deformis* (Reuss). Bold, 1965b, p. 396, pl. 5, figs. 4a, b; Bold, 1972b, p. 427, tables 1, 2, 5; Bold, 1973b, p. 164, pl. 1, figs. 4a–c; Sánchez-Arango, 1977, table 2; Kusnetzov *et al.*, 1977, p. 52; Furrazola Bermúdez *et al.*, 1978, p. 40; Bold, 1978b, table 10; Bold, 1981, tables 2–5, 8, 10, 11; Bold, 1982, table 2.

Holotype.—Uncertain.

Type locality.—Nussdorf, Austria.

Stratigraphic horizon.—Badenian, middle Miocene.

Dimensions.—Carapace, L: 0.74; H: 0.46; W: 0.45 (Laguana amber site, No. 15).

Material.—Two specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4). Laguana amber site: (Table 5).

Distribution.—Lower to upper Miocene: Antilles, Central America.

Procythereis? **howei** Bold

Brachycythere deformis (Reuss). Bold, 1946, p. 107 (part, not pl. 13, figs. 2a–d).
Procythereis sp. Bold, 1969, p. 121, pl. 2, fig. 11, text-fig. 4a.
Procythereis? *howei* Bold, 1975c, p. 149, pl. 19, figs. 11–14.

Holotype.—HVH No. 9141 (Bold, 1975c, pl. 19, fig. 11).

Type locality.—Loc. CU 39, Santiago de Cuba (Bold, 1975c, p. 135, text-fig. 14).

Stratigraphic horizon.—Basal La Cruz Formation (uppermost Miocene to Pliocene).

Dimensions.—HVH No. 10808 (carapace), L: 0.64; H: 0.40; W: 0.40 (loc. TU 1447).

Material.—Two specimens.

Occurrence.—Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Pleistocene: Greater Antilles.

Genus **AURILA** Pokorný, 1955

Aurila auricula (Teeter)
Plate 4, figure 6

Aurila, n. sp. Bold, 1975c, p. 146, pl. 17, figs. 2–8.
Hemicythere? *auricula* Teeter, 1975, p. 437, figs. 7u, 8f, 9h, i.

Holotype.—HVH No. 8994.

Type locality.—Loc. 315 of Teeter (1975), off the coast of Belize (10 ft water depth).

Stratigraphic horizon.—Recent.

Diagnosis.—A species of *Aurila*, characterized by a conspicuous angulation in the middle of the dorsal margin of both valves.

Dimensions.—HVH No. 10558 (left valve), L: 0.63; H: 0.30 (loc. NMB 17012).

Material.—Nine specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1).

Distribution.—Pliocene to Recent: Cuba, Dominican Republic; Recent: Belize.

Aurila macropunctata (Bold)

Brachycythere trigonalis (Jones) var. *macropunctata* Bold, 1946, p. 108, pl. 13, figs. 12a–c.
Hemicythere amygdala Stephenson. Puri and Hulings, 1957, p. 174; Puri, 1960, p. 129, text-figs. 31, 32 [not *Hemicythere amygdala* Stephenson, 1944, p. 158, pl. 28, figs. 8, 9].
Aurila amygdala (Stephenson). Benson and Coleman, 1963, p. 36, pl. 8, figs. 6, 8, 9, pl. 9, fig. 22.
Aurila aff. *convexa* (Baird). Bold, 1964, p. 10.
Aurila sp. aff. *A. cicatricosa* (Reuss). Bold, 1966c, p. 26, pl. 3, figs. 6a, b; Bold, 1969, p. 122, pl. 2, figs. 6a, b; Bold, 1973a, table 1; Bold, 1975a, table 9; Bold, 1975d, table 1; Bold, 1981, p. 80, pl. 4, figs. 4a, b, tables 9, 10.
Aurila sp. cf. *A. amygdala* (Stephenson). Kontrovitz, 1978, p. 143, pl. 2, fig. 3.

Holotype.—GIRU S 13050.

Type locality.—Loc. T 1439, 2 km SW of Banes along road to Santa Isabel de Nipe, just west of Antilles, Oriente Province, Cuba.

Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (= Júcaro Formation of Kozary, 1957, Jakus, 1983, p. 62).

Dimensions.—GIRU S 13050 (carapace, holotype), L: 0.67; H: 0.46; W: 0.28. HVH No. 7914 (carapace), L: 0.66; H: 0.44; W: 0.35 (loc. Caiguire 2, Cumaná Formation, Pleistocene, Venezuela); HVH No. 8744 (carapace), L: 0.66; H: 0.43; W: 0.35 (loc. PR 6, Ponce Cement Quarry, Puerto Rico); HVH No. 10809 (left valve), L: 0.64; H: 0.42 (Cul-de-Sac borehole #12, Morne Delmas Formation, Haiti); HVH No. 10027 (left valve), L: 0.63; H: 0.43 (loc. K 259, Rivière Féliciane, Las Cahobas Formation, Haiti); HVH No. 10599 (carapace), L: 0.59; H: 0.40; W: 0.33 (loc. TU 1445).

Remarks.—This species is similar in general appearance to *A. amygdala* (Stephenson), but is higher, has a less convex dorsal margin and a stronger anteroventral indentation in the right valve. In dorsal view it has less convex sides and is a little more angular at the greatest width.

Material.—Ten specimens.

Occurrence.—Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Recent: Venezuela; Pliocene: Puerto Rico; upper Miocene to Pliocene: Hispaniola; upper Miocene: Cuba; Recent: Gulf of Mexico.

Aurila amygdala (Stephenson)

Hemicythere amygdala Stephenson, 1944, p. 158, pl. 28, figs. 8, 9.
Aurila amygdala (Stephenson). Butler, 1963, p. 73, pl. 2, fig. 16, pl. 6, fig. c; Bold, 1965b, p. 394, pl. 5, fig. 10; Bold, 1970b, tables 1, 3, 5; Bold, 1971a, table 2; Bold, 1972a, tables 2, 3; Bold, 1972b, p. 427, tables 1–5, 7; Bold, 1973a, table 1; Poag, 1974, p. 59, pl. 6, fig. 5; Bold, 1975d, table 4; Kusnetzov *et al.*, 1977, p. 52; Bold, 1981, tables 2, 4, 11; Bold, 1982, tables 2, 4.

Holotype.—HVH No. 2359.

Type locality.—Stanolind well No. B-2, core at 5876–5880 ft, Jefferson County, Texas.

Stratigraphic horizon.—Anahuac Formation (lower Miocene).

Dimensions.—HVH No. 10810 (carapace), L: 0.59; H: 0.41; W: 0.34 (loc. NMB 17189).

Material.—Fourteen specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4).

Distribution.—Upper Oligocene to middle Miocene: Caribbean and Gulf Coast.

Aurila galerita Bold

Brachycythere cicatricosa (Reuss). Bold, 1946, p. 106, pl. 13, figs. 1a–f [not *Cypridina cicatricosa* Reuss, 1850, p. 67, pl. 9, fig. 21].
Aurila trigonula (Jones). Bold, 1957b, p. 239, pl. 4, fig. 6; Bold, 1958, table 1 [not *Cythere trigonula* Jones, 1857, p. 25, pl. 3, figs. 1a–h].
Aurila galerita Bold, 1965b, p. 395, pl. 5, figs. 9a, b; Bold, 1970b, table 1; Bold, 1971a, table 2; Bold, 1972b, p. 418, tables 1–5; Bold, 1973a, p. 155, table 1; Bold, 1976, table 4; Sánchez-Arango, 1977,

table 2; Kusnetzov *et al.*, 1977, p. 53; Bold, 1978b, table 10; Bold, 1981, pp. 14, 18, 103, 108, tables 2, 3, 10; Bold, 1982, table 2.

Holotype.—USNM 648995 (Bold, 1965b, pl. 5, figs. 9a, b).

Type locality.—Loc. 71, north of San Sebastian, Puerto Rico (Bold, 1965b, text-fig. 1).

Stratigraphic horizon.—Cibao Formation (middle Miocene).

Dimensions.—HVH No. 10811 (carapace), L: 0.63; H: 0.40; W: 0.35 (Laguana amber site).

Material.—About 50 specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4). Laguana and Bayaguana amber sites: (Table 5).

Distribution.—Lower to upper Miocene: Antilles, Central America.

Genus **CAUDITES** Coryell and Fields, 1937

Caudites medialis Coryell and Fields
Plate 3, figure 7

Caudites medialis Coryell and Fields, 1937, p. 11, pl. 2, figs. 12a–c; Bold, 1966e, p. 360, pl. 1, fig. 7, table 1; Bold, 1967a, table 1; Bold, 1967b, p. 311, pl. 1, fig. 4, table 1; Bold, 1968, p. 19, pl. 4, figs. 1a, b, tables 6, 8–10; Bold, 1981, p. 19.
Caudites sp. aff. *C. sellardsi* (Howe and Neill). Bold, 1966a, p. 7.

Holotype.—AMNH 24806.

Type locality.—Cativa, Panama.

Stratigraphic horizon.—Gatun Formation (upper Miocene).

Reference material.—HVH No. 8223.

Reference locality.—Loc. P 12, on side road south of transisthmus highway, 2 km west of Cativa, Panama.

Stratigraphic horizon.—Gatun Formation (upper Miocene).

Dimensions.—HVH No. 10540 (carapace), L: 0.52; H: 0.28; W: 0.19 (loc. NMB 16964).

Material.—More than 30 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Distribution.—Middle Miocene to lower Pliocene: Panama, Costa Rica, Colombia, Jamaica, Dominican Republic.

Caudites nipeensis Bold
Plate 3, figure 8

Caudites nipeensis Bold, 1946, p. 105, pl. 14, fig. 1; Keij, 1954, p. 224, pl. 4, fig. 14, pl. 6, figs. 11a–d; Bold, 1957b, p. 239; Bold, 1963b, p. 386, pl. 6, figs. 3a, b; Bold, 1964, table 2; Baker and Hulings, 1966, p. 114, pl. 1, fig. 5; Bold, 1966b, p. 5; Bold, 1966c, tables 1, 2; Bold, 1966e, p. 361, table 1; Bold, 1968, tables 7–10; Bold, 1969, table 1; Bold, 1970b, p. 47, pl. 2, fig. 12; Bold, 1971b, tables 2–5; Bold, 1972a, table 2; Bold, 1973a, table 2; Bold, 1973b, p. 334; Teeter, 1975, p. 443, figs. 10d, 11e; Bold, 1975c, tables 2, 4, 5; Bold, 1978b, tables 8, 9; Bold, 1981, p. 108, table 13.

Holotype.—GIRU S 13040.

Type locality.—Loc. T 1451, outcrop on shore of Bahia de Nipe, Oriente Province, Cuba.

Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (= Júcaro Formation of Kozary, 1957, Jakus, 1983, p. 62).

Diagnosis.—A species of *Caudites* with a two-pronged dorsal ridge.

Dimensions.—HVH No. 10541 (carapace), L: 0.56; H: 0.30; W: 0.21 (loc. NMB 16125).

Material.—More than 80 specimens.

Remarks.—Two specimens found in the López part of the Río Yaque del Norte section have the ventral ridge split up into two nodules, and may belong to a form ancestral to *C. nipeensis.*

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Cercado, Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (?López, Arroyo López, Santiago): (Table 4).

Distribution.—Middle Miocene to Recent: Caribbean.

Caudites rectangularis (Brady)
Plate 3, figures 9, 10

Cythere rectangularis Brady, 1869, p. 153, pl. 16, figs. 13, 14.
Caudites leguminosus Bold, 1963c, p. 387, pl. 6, figs. 2a, b.
Caudites rectangularis (Brady). Bold, 1966a, p. 46, pl. 4, figs. 2a, b; Bold, 1968, tables 6, 9; Bold, 1971b, pl. 3, figs. 8a–c, tables 3 (part), 4 (part) [not pl. 3, figs. 8d–f = *Caudites highi* Teeter, 1975, p. 445, figs. 10g, 11d–f]; Bold, 1975c, tables 2, 5; Bold, 1978b, table 9; Bold, 1981, tables 14, 15.

Holotype.—Hancock Museum, Newcastle-upon-Tyne, England, U. K.

Type locality.—Colón Harbor, Panama.

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 8251.

Reference locality.—Colón Harbor, Panama.

Dimensions.—HVH No. 10542 (carapace), L: 0.54; H: 0.36; W: 0.15 (loc. NMB 16973).

Material.—Ten specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao (Table 3).

Distribution.—Upper Miocene to Recent: Greater Antilles, Trinidad, Costa Rica; Recent: Panama, Belize.

Caudites sacer Bold

Caudites medialis Coryell and Fields. Bold, 1957b, p. 329, pl. 3, fig. 6 [not *Caudites medialis* Coryell and Fields, 1937, p. 11, pl. 2, figs. 12a–c].
Caudites, n. sp. aff. *C. medialis* Coryell and Fields. Bold, 1971a, table 2.
Caudites sacer Bold, 1970b, p. 46, pl. 1, figs. 3a, b, tables 1, 2; Bold, 1981, table 2.

Holotype.—HVH No. 8708 (Bold, 1970b, pl. 1, fig. 3a).

Type locality.—Loc. SM-4, Mullett Pond Bay, St. Martin, Lesser Antilles.

Stratigraphic horizon.—Lowlands Formation (lower middle Miocene).

Dimensions.—Carapace, L: 0.55; H: 0.28; W: 0.18 (loc. NMB 17189, No. 20).

Material.—Three specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4).

Distribution.—Upper lower to lower middle Miocene: Hispaniola, St. Croix, St. Martin, Trinidad.

Caudites species

In the Gurabo and Mao formations of the Río Gurabo section (Table 2), *Caudites nipeensis* is accompanied by specimens that could not be identified with certainty as its molts. Therefore these have been recorded as *Caudites* sp.

Genus **ORIONINA** Puri, 1954

Orionina serrulata (Brady)

Orionina serrulata (Brady). Bold, 1963a, p. 44, pl. 5, figs. 1–6, text-fig. 5, figs. 6, 7, 8a–d (with synonymy); Bold, 1963c, p. 386, pl. 6, fig. 7; Bold, 1964, table 2; Bold, 1966c, tables 1, 2; Bold, 1966d, p. 47, pl. 1, fig. 8; Bold, 1966e, table 1; Baker and Hulings, 1966, p. 114, pl. 1, fig. 9; Bold, 1968, table 11 (not tables 4–6, 9, 10 = *O. vaughani*); Bold, 1971b, tables 3–5, 6 (part); Bold, 1972a, table 2; Bold, 1975c, p. 147, tables 4, 5; Teeter, 1975, p. 447, figs. 11h, 12a; Bold, 1978b, table 9; Bold, 1981, table 14; Breman, 1982, p. 237.

Orionina bermudae (Brady). Swain and Gilby, 1974, p. 328 (part), pl. 32, fig. 24 [not pl. 31, figs. 14a, b, pl. 35, fig. 7, text-fig. 17C].

Holotype.—Hancock Museum, Newcastle-upon-Tyne, England, U. K.

Type locality.—Colón Harbor, Panama.

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 8270.

Reference locality.—Colón Harbor, Panama.

Dimensions.—Left valve, L: 0.62; H: 0.33 (loc. NMB 16039, No. 41).

Occurrence.—Río Gurabo: Mao Formation (Table 2). Río Mao (Table 3).

Distribution.—Pliocene to Recent: Hispaniola, Jamaica, Puerto Rico, ?Costa Rica; upper Miocene to Recent: Trinidad, Venezuela, Colombia, Panama.

Orionina vaughani (Ulrich and Bassler)
Plate 4, figure 7

Orionina vaughani (Ulrich and Bassler). Bold, 1963a, p. 41, pl. 3, figs. 1–5, text-fig. 5, figs. 1–4 (with synonymy); Bold, 1963b, p. 386, pl. 6, fig. 8; Puri, 1963, p. 376; Bold, 1964, table 2; Hall, 1965, p. 35; pl. 7, figs. 4, 5, 7; Bold, 1965b, p. 395, table 1; Bold, 1966f, p. 139, pl. 45, fig. 3; Swain, 1968, p. 21, pl. 4, figs. 4a–c, text-fig. 19; Puri and Vanstrum, 1969, pp. 74, 76, 78; Bold, 1970b, p. 40, table 1; Bold, 1972a, table 2; Bold, 1972b, p. 428; Bold, 1973a, table 1; Swain, 1974, p. 35, pl. 7, fig. 17, pl. 12, figs. 4a–h; Lubimova and Sánchez-Arango, 1974, pl. 15, figs. 4, 4a; Bold, 1975d, table 2; Hazel, 1977, fig. 8a; Bold, 1978b, table 2; Sanguinetti, 1979, p. 149, pl. 6, figs. 5a–c, pl. 13, figs. 2a, b; Forester, 1980, p. 19; Bold, 1981, table 11; Bold, 1982, table 2; Hazel, 1983, pl. 12, fig. 1.

Orionina serrulata (Brady). Bold, 1968, tables 4–6, 10 (not table 9 = *O. serrulata*).

Holotype.—USNM 35422 [reported broken (Bold, 1963a), and lost (Forester, 1980)].

Type locality.—Only reported as Chesapeake group (Miocene) by Ulrich and Bassler (1904).

Reference material.—HVH No. 1073.

Reference locality.—Loc. K. E. Young 34, near Ward, Florida.

Stratigraphic horizon.—Choctawhatchee Stage (late Miocene).

Dimensions.—HVH No. 10560 (right valve, female), L: 0.70; H: 0.41 (loc. NMB 16964); HVH No. 10812 (left valve, male), L: 0.81; H: 0.43 (loc. TU 1447).

Material.—About 50 specimens.

Remarks.—Cronin (written commun., 1985) suggests that *O. vaughani* and *O. serrulata* could represent a single species that sometimes may have branching marginal pore canals (*O. serrulata*) and sometimes straight and simple ones (*O. vaughani*). I think that this is unlikely, because only the form with branching pore canals has been found in Recent deposits. It is restricted to the Caribbean biogeographic province (Bold, 1970a), while the Recent species with straight pore canals (*O. bradyi* Bold, 1963a) replaces *O. vaughani* on the Atlantic coasts and the northern fringes of the Caribbean Province. Inside the Caribbean it has only been found on the Nicaragua, Belize and Cuban shelves.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao (Table 3). Río Yaque del Norte (Baitoa, López, Arroyo López): (Table 4).

Distribution.—Lower Miocene to upper Miocene: Trinidad, Venezuela, Panama, Colombia; lower Miocene to Pliocene: Hispaniola; lower Miocene to Pleistocene: Cuba, North America, ?Mexico.

Genus **QUADRACYTHERE** Hornibrook, 1952

Quadracythere howei (Puri)
Plate 3, figure 11

Hemicythere howei Puri, 1953a, p. 176, pl. 1, figs. 7–9; Puri, 1954, p. 357.

Hemicythere bichensis Bold, 1963b, p. 385, pl. 6, figs. 9a, b.

Quadracythere bichensis (Bold). Bold, 1968, p. 57, pl. 5, fig. 2, tables 4–6; Bold, 1969, table 1; Bold, 1975a, tables 9, 10; Bold, 1975d, table 1; Bold, 1981, tables 4, 6.

Quadracythere fuenmayorensis Rodríguez, 1969, p. 197, pl. 3, figs. 9, 10, text-fig. 16.

Holotype.—HVH No. 2473.
Type locality.—Loc. 27 of Puri (1953a), Washington County, Florida.
Stratigraphic horizon.—Jackson Bluff Formation, *Arca* Zone (upper Miocene).
Dimensions.—HVH No. 10544 (left valve), L: 0.56; H: 0.33 (loc. NMB 16176).
Material.—Fourteen specimens.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).
Distribution.—Upper Miocene to Pleistocene: Florida, Hispaniola, Jamaica, Puerto Rico, Trinidad, Venezuela.

Quadracythere producta (Brady)
Plate 3, figure 12

Cythere producta Brady, 1868, p. 378, pl. 59, figs. 7a–c.
Quadracythere producta (Brady). Bold, 1968, p. 57, pl. 5, figs. 1a, b, tables 2, 9, 11; Bold, 1969, table 1; Bold, 1971b, tables 3–5; Bold, 1975a, tables 2, 6, 9; Bold, 1975c, tables 2, 4, 5; Teeter, 1975, p. 441, figs. 9m, n, 10b; Sánchez-Arango, 1977, p. 23, fig. 2; Kusnetzov *et al.*, 1977, p. 53; Furrazola Bermúdez *et al.*, 1978, p. 40 (table); Bold, 1978b, tables 2, 9; Bold, 1981, p. 107; Bold, 1983, fig. 7.

Holotype.—Hancock Museum, Newcastle-upon-Tyne, England, U. K.
Type locality.—Honduras, shallow water in calcareous sand.
Stratigraphic horizon.—Recent.
Dimensions.—HVH No. 10545 (right valve), L: 0.55; H: 0.32 (loc. NMB 16097).
Material.—Fourteen specimens.
Occurrence.—Río Gurabo: Mao Formation (Table 2). Río Mao: (Table 3).
Distribution.—Pliocene to Recent: Greater Antilles, Costa Rica, Mexico; Recent: Honduras and Belize.

Quadracythere brachypygaia Bold

Quadracythere brachypygaia Bold, 1965b, p. 396, pl. 6, figs. 6a, b; Bold, 1972b, tables 1, 2, 4; Bold, 1982, tables 2, 3.

Holotype.—HVH No. 7752 (Bold, 1965b, pl. 6, figs. 6a, b).
Type locality.—Loc. 50, N. of San Sebastian, Puerto Rico (Bold, 1965b, text-fig. 1).
Stratigraphic horizon.—Upper part of San Sebastian Formation (Oligocene).
Dimensions.—Left valve, L: 0.51; H: 0.33 (loc. NMB 17193, No. 4).
Material.—One specimen.
Occurrence.—Río Yaque del Norte (Baitoa): (Table 4).
Distribution.—Upper Oligocene to lower Miocene: Hispaniola, Puerto Rico, Panama.

Genus **JUGOSOCYTHEREIS** Puri, 1954

Jugosocythereis pannosa (Brady)
Plate 3, figure 13

Cythere pannosa Brady, 1869, p. 154, pl. 10, figs. 1, 2.
Jugosocythereis pannosa (Brady). Bold, 1966b, p. 14; Bold, 1966d, p. 47, pl. 1, fig. 11; Bold, 1971b, table 1; Benson, 1972, pl. 2, fig. 1; Maddocks, 1974, p. 210, pl. 5, figs. 1, 5, 6, 8, 9; Bold, 1975c, tables 2, 4, 5; Teeter, 1975, p. 499, figs. 11m, n, 12d; Holden, 1976, p. 25, pl. 3, figs. 17–21, pl. 12, fig. 14; Bold, 1978a, table 2; Bold, 1978b, table 9; Bold, 1981, p. 110, table 10.

Holotype.—Hancock Museum, Newcastle-upon-Tyne, England, U. K.
Type locality.—Colón Harbor, Panama.
Stratigraphic horizon.—Recent.
Reference material.—HVH No. 8281.
Reference locality.—Loc. P 16, Colón Harbor, Panama (Bold, 1966d).
Diagnosis.—A species of *Jugosocythereis* with high-crested system of median ridges, pronounced dorsal and ventral ridge.
Dimensions.—HVH No. 10546 (right valve), L: 0.98; H: 0.66 (loc. NMB 16125).
Material.—About 20 specimens.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3).
Distribution.—Upper Miocene to Recent: Caribbean.

Jugosocythereis vicksburgensis (Howe and Law)

Cythereis (?) *vicksburgensis* Howe and Law, 1936, p. 34, pl. 4, fig. 4, pl. 5, figs. 1, 2; Bold, 1946, p. 69, pl. 10, fig. 5.
Hermanites pannosa (Brady). Bold, 1957b, p. 240, pl. 2, fig. 2 [not *Cythere pannosa* Brady, 1869, p. 154, pl. 10, figs. 1, 2].
Jugosocythereis vicksburgensis (Howe and Law). Bold, 1960, p. 169, table 3; Bold, 1965b, p. 397, pl. 5, figs. 2a, b; Deboo, 1965, pl. 13, fig. 18; Laurencich, 1969, p. 498, pl. 1, fig. 3; Bold, 1970b, tables 1, 2, 4; Bold, 1972a, tables 2, 3, 4; Bold, 1972b, p. 428, tables 1, 2, 4; Benson, 1972, pl. 2, fig. 2; Poag, 1974, p. 668, pl. 9, fig. 10, pl. 10, figs. 1, 2; Bold, 1975d, tables 3, 4; García-Mendez, 1978, table 1; Furrazola Bermúdez *et al.*, 1978, p. 40; Bold, 1978b, tables 3, 5, 6; Hazel, Mumma, and Huff, 1980, pl. 6, figs. 4, 5; Bold, 1981, p. 103, tables 2, 3, 11, 13.
Quadracythere boldi Butler, 1963, p. 65, pl. 4, figs. 7, 8.
Trachyleberis aff. *T. vicksburgensis* (Howe and Law). Lubimova and Sánchez-Arango, 1974, pl. 13, figs. 5, 5a.
Quadracythere vicksburgensis (Howe and Law). Howe, 1977, pl. 1, figs. 1, 2.

Diagnosis.—This species differs from the preceding one by its less complex structure, while the ridges of the reticulation are wider and usually lower.
Holotype.—HVH No. 1732 (Howe and Law, 1936, pl. 4, fig. 4).
Type locality.—HVH loc. 2, Byram, Mississippi (Howe and Law, 1936, p. 12).
Stratigraphic horizon.—Byram marl (Oligocene).

Dimensions.—Left valve, juvenile, L: 0.50; H: 0.28 (loc. NMB 17186, No. 6).

Material.—Three specimens.

Remarks.—*J. vicksburgensis* grades morphologically into its descendant *J. pannosa,* and it has not yet been established at which level (probably somewhere in the upper Miocene) the change takes place. Especially immature molts cannot be assigned with any degree of certainty to one species or the other, which is the reason why two immature specimens in the lower part of the Arroyo López section (Table 4), have been questionably assigned to *J. vicksburgensis.*

Occurrence.—Río Yaque del Norte (López, questionably Arroyo López, two juveniles): (Table 4).

Distribution.—Eocene to middle Miocene (?upper Miocene): Caribbean, Gulf Coast.

Subfamily **THAEROCYTHERINAE** Hazel, 1967a

Genus **HERMANITES** Puri, 1955

Hermanites hornibrooki (Puri)

Plate 3, figure 18

Hermanites aff. *thoracophora* (Bold). Keij, 1954, p. 223, pl. 4, figs. 12a, b.
Hermanites aff. *hutchisoni* Bold. Bold, 1957b, p. 240.
Hermanites sp. 2. Drooger and Kaasschieter, 1958, p. 240.
Bradyleya hornibrooki Puri, 1960, p. 123, pl. 1, figs. 9, 10 (not text-figs. 27, 28).
Hermanites hornibrooki (Puri). Bold, 1966b, p. 5; Bold, 1966d, pl. 1, fig. 14; Bold, 1968, p. 66, pl. 4, fig. 3; Bold, 1971b, tables 3–5; Bold, 1975c, tables 4, 5; Teeter, 1975, p. 419, figs. 11a, 12a; Bold, 1978b, table 9; Bold, 1983, fig. 2.

Diagnosis.—A small species of *Hermanites* with well-developed subcentral tubercle and dorsal and ventral ridges. Greatest width at subcentral tubercle.

Holotype.—FGS S 5206.

Paratypes.—HVH Nos. 4720, 4721.

Type locality.—Bahia Honda, Florida Keys.

Stratigraphic horizon.—Recent.

Dimensions.—HVH No. 10549 (carapace), L: 0.47; H: 0.23; W: 0.23 (loc. NMB 17183).

Material.—More than 50 specimens.

Remarks.—The difference from *H. hutchisoni* Bold, 1957b (p. 240, pl. 3, figs. 1a, b) lies in the position of greatest width.

Occurrence.—Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Recent: Caribbean, Gulf of Mexico.

Hermanites tschoppi (Bold)

Cythereis tschoppi Bold, 1946, p. 93, pl. 10, figs. 14a, b.
Hermania reticulata Puri, 1954, p. 267, pl. 11, fig. 9, text-figs. 9g, h.
Hermanites reticulata (Puri). Puri, 1955, p. 358; Benson, 1972, pl. 1, fig. 10.
Hermanites haidingeri (Reuss). Bold, 1957b, p. 239, pl. 2, figs. 1a, b [not *Cypridina haidingeri* Reuss, 1850, p. 78, pl. 10, figs. 13a, b].
Hermanites tschoppi (Bold). Bold, 1960, p. 170; Bold, 1965b, p. 398, pl. 6, figs. 2a, b; Bold, 1970b, tables 1, 3; Bold, 1971a, table 2; Bold, 1972b, p. 428, tables 2, 4, 6; Bold, 1973a, table 1; Poag, 1974, p. 68, pl. 9, fig. 9; Bold, 1975d, table 4; Bold, 1976, table 4; Bold, 1978b, tables 3, 5, 10; Bold, 1981, p. 15, 26, pl. 4, fig. 3, table 3; Bold, 1982, tables 3, 4.
Hermanites fungosa Butler, 1963, p. 63, pl. 4, figs. 4–6.
Not *Hermanites reticulata* (Puri). Hulings, 1967b, p. 654, figs. 4 (1, 7a) [= *H. transoceanica* Teeter, 1975, p. 450, figs. 11o–q, 12h].
Not *Hermanites tschoppi* (Bold). Holden, 1976, p. 27, pl. 4, figs. 6–9, pl. 12, fig. 5, pl. 13, figs. 3, 4.

Holotype.—GIRU S 13019.

Type locality.—Loc. W 206, West Oriente Province, Cuba (Bold, 1946, p. 127; Bold, 1973a, p. 148).

Stratigraphic horizon.—Paso Real Formation (lower Miocene).

Dimensions.—Right valve, L: 0.57; H: 0.31 (loc. NMB 17189, No. 4).

Material.—Two specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4).

Distribution.—Oligocene to middle Miocene: Caribbean, Gulf Coast.

Genus **BRADLEYA** Hornibrook, 1952

Bradleya ex gr. **dictyon** (Brady)

Bradleya ex gr. *dictyon* (Brady). Bold, 1968, table 12; Bold, 1971b, table 4; Bold, 1975a, table 13; Bold, 1978b, table 9.
Not *Bradleya* ex gr. *dictyon* (Brady). Bold, 1972a, tables 2, 3, 4; Bold, 1972b, tables 1–4; Bold, 1973a, table 1; Bold, 1975d, table 3; Bold, 1978b, table 7; Bold, 1981, p. 107, tables 8, 12, 13, 14 [= *Bradleya johnsoni* Benson (*in* Benson and Peypouquet, 1983, p. 811, pl. 3, fig. 8)].
?*Bradleya dictyon* (Brady). Benson, 1972, p. 34, pl. 8, figs. 7, 8, pl. 9, figs. 1–12, pl. 11, fig. 18 (lectotype).
Not *Bradleya dictyon* (Brady). Bold, 1981, pp. 104, 108, pl. 4, fig. 17; Steineck, 1981, table 2, p. 345; Steineck *et al.*, 1984, figs. 6H–K, 14, 15, tables 4, 5 [= *Bradleya johnsoni* Benson (*in* Benson and Peypouquet, 1983, p. 811, pl. 3, fig. 8)].

Remarks.—Steineck (written commun., 1985) informed me about the identity of the species of *Bradleya* from the Montpelier Group in Jamaica and the Thomonde Formation in Haiti with *Bradleya johnsoni* Benson. The latter species is now known from the lower and middle Miocene. The upper Miocene and Pliocene species from the Caribbean may be a new species, but for the time being, I prefer to refer to it as *B.* ex gr. *dictyon* (Brady).

Dimensions.—HVH No. 8297 (left valve), L: 0.76; H: 0.53 (loc. H 15101).

Occurrence.—Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Pliocene (?late Miocene), Caribbean.

Subfamily **COQUIMBINAE** Ohmert, 1968

Genus **COQUIMBA** Ohmert, 1968

Coquimba congestocostata (Bold)
Plate 3, figure 17

Puriana? *congestocostata* Bold, 1963b, p. 390, pl. 7, figs. 5a, b, pl. 12, fig. 9; Bold, 1964, table 2; Bold, 1966b, p. 5; Bold, 1968, pl. 5, figs. 3a–c, tables 4–8, 10, 13.
Coquimba congestocostata (Bold). Bold, 1971b, p. 337, tables 2, 3–6; Bold, 1975a, tables 2, 11; Bold, 1975c, tables 3, 4; Bold, 1978b, table 9; Bold, 1981, p. 81, pl. 4, fig. 6, table 13; Bold, 1983, pp. 407, 411, figs. 1, 5.

Diagnosis.—An elongate species of *Coquimba* with narrow, irregular fossae and broad ridges separating them.

Holotype.—USNM 689080.

Paratypes.—HVH No. 6862.

Type locality.—Loc. R 3776A, Mamural road, Central Range, Trinidad.

Stratigraphic horizon.—San Jose calcareous silt member of the Manzanilla Formation (upper Miocene).

Dimensions.—HVH No. 10548 (left valve), L: 0.68; H: 0.38 (loc. NMB 16125).

Material.—Twenty-six specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).

Distribution.—Upper Miocene to Pliocene: Greater Antilles, Trinidad, Costa Rica.

Coquimba minuta (Bold)
Plate 3, figure 16

Puriana minuta Bold, 1963b, p. 390, pl. 8, figs. 2a, b; Bold, 1964, table 2; Bold, 1966b, p. 5; Bold, 1966c, pp. 14, 15, tables 1, 2; Bold, 1966d, pl. 4, fig. 4; Bold, 1968, table 7; Bold, 1970a, table 1; Bold, 1972a, table 3.
Coquimba minuta (Bold). Bold, 1971b, p. 337, tables 2, 4, 5; Bold, 1978b, table 9.

Diagnosis.—A small species of *Coquimba* resembling a species of *Puriana,* but with muscle scars typical of *Coquimba,* and without much ornamentation.

Holotype.—USNM 68007.

Paratypes.—HVH No. 6869.

Type locality.—Loc. R 12528, between Flanagan Town and Mamural, Central Range, Trinidad.

Stratigraphic horizon.—Gransaul clay member of the Springvale Formation (upper Miocene).

Dimensions.—HVH No. 10547 (carapace), L: 0.51; H: 0.25; W: 0.27 (loc. NMB 16097).

Material.—Two specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Mao Formation (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Recent: Jamaica, Dominican Republic, Trinidad, Venezuela, Costa Rica.

Subfamily **TRACHYLEBERIDINAE**
Sylvester-Bradley, 1948

Genus **TRACHYLEBERIDEA** Bowen, 1953

Trachyleberidea mammidentata (Bold)
Plate 5, figures 5, 6

Cythereis cubensis var. *mammidentata* Bold, 1946, p. 91, pl. 10, figs. 23a–d; Bold, 1950, p. 107, table 1.
Trachyleberidea cubensis mammidentata (Bold). Bold, 1963c, p. 396; Bold, 1966b, p. 5.
Trachyleberidea mammidentata (Bold). Bold, 1967a, p. 8; Bold, 1968, p. 57, pl. 5, figs. 5a, b, figs. 7a, b, tables 11, 12; Bold, 1970b, table 1; Bold, 1971a, tables 1, 2; Bold, 1971b, tables 3–5; Bold, 1973b, table 1; Bold, 1975a, table 11; Bold, 1975c, table 2; Bold, 1975d, table 3; Kusnetzov *et al.,* 1977, p. 52; Furrazola Bermúdez *et al.,* 1978, p. 40 (table); García-Mendez, 1978, table 1; Bold, 1981, pp. 53, 96, 102, 106, 110, 115, pl. 4, fig. 14, tables 3, 7, 8, 12, 13; Steineck, 1981, p. 346, pl. 1, fig. 12, table 2.
?*Trachyleberidea pretiosa* Levinson *in* LeRoy and Levinson, 1974, p. 22, pl. 14, figs. 1–5; Cronin, 1983, pl. 3, fig. 8.

Diagnosis.—A species of *Trachyleberidea* with coarse anterior denticulation.

Holotype.—GIRU S 13012.

Type locality.—Loc. T 1479, on road from Sierra de Nipe to Mayarí, 3.5 km S of Mayarí, Oriente Province, Cuba.

Stratigraphic horizon.—Lower Nipe Formation, lower Miocene (? = Jagüeyes Formation of Kozary, 1957, Jakus, 1983, p. 60).

Dimensions.—HVH No. 10554 (left valve), L: 0.79; H: 0.46 (loc. NMB 16103).

Material.—Ten specimens.

Remarks.—There are some subtle changes in morphology during the evolution of this species from the late Oligocene to the Pliocene, but they do not appear to be greater than variation in morphology in local populations. The Pleistocene to Recent species *T. pretiosa* appears to fall within the range of variability and for this reason it is tentatively considered as synonymous.

Occurrence.—Río Cana: Mao Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Oligocene to Recent: Greater Antilles; Pleistocene to Recent: Gulf of Mexico, Atlantic coast?

Genus **TRACHYLEBERIS** Brady, 1898

Trachyleberis? **bermudezi crebripustulosa** Bold

Trachyleberis bermudezi crebripustulosa Bold, 1966a, p. 181, pl. 22, figs. 8a, b; Bold, 1966c, table 2; Bold, 1971b, tables 3, 4; Bold, 1972a, table 4; Bold, 1978b, tables 4, 7; Bold, 1981, pp. 53, 102, 115, pl. 4, figs. 10, 11, tables 11, 23, 14.
"*Hyphalocythere*" sp. Benson *in* Hsu *et al.,* 1978, pl. 2, fig. 1.
Echinocythereis acanthoderma (Brady). Breman, 1982, pl. 1, fig. B.

Not *Trachyleberis bermudezi crebripustulosa* Bold. Carreño, 1982, p. 57.

Diagnosis.—A large species of *Trachyleberis*? or "*Hyphalocythere*" (nom. nud.), densely covered with large, sometimes branching spines, except for a more or less circular area around the pronounced subcentral group of tubercles.

Holotype.—HVH No. 7886.

Type locality.—Loc. RM 19303, Pozón–El Mene road, Falcón, Venezuela.

Stratigraphic horizon.—Base of Husito marly clay (lowermost middle Miocene).

Dimensions.—HVH No. 10813 (left valve), L: 0.91; H: 0.51 (loc. H 15101).

Material.—Six specimens.

Occurrence.—Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Middle Miocene to Recent: Caribbean deep-water deposits.

Genus **COSTA** Neviani, 1928

Costa dohmi Bold
Plate 5, figure 3

Costa dohmi Bold, 1968, p. 59, pl. 3, figs. 9a–d, tables 6–8, 11; Bold, 1970a, p. 71; Bold, 1971b, p. 338 (part), tables 2, 5 [not pl. 2, fig. 7, tables 3, 4]; Bold, 1981, p. 78, table 15.

Diagnosis.—A species of *Costa* with short longitudinal ridge between ventral and median ridge.

Holotype.—HVH No. 8311.

Type locality.—Loc. H 15269 on Valverde–Monción road, 300 m east of Las Quemadas, Dominican Republic (Bold, 1968, text-fig. 3).

Stratigraphic horizon.—Gurabo Formation (Pliocene).

Dimensions.—HVH No. 10552 (right valve), L: 0.62; H: 0.37 (loc. NMB 15978).

Material.—More than 50 specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Pliocene: Jamaica, Hispaniola.

Costa bellipulex Levinson
Plate 5, figures 1, 2

Costa dohmi Bold. Bold, 1971b, pl. 2, fig. 7, tables 3, 4 [not *C. dohmi* Bold].
Costa bellipulex Levinson *in* LeRoy and Levinson, 1974, p. 20, pl. 13, fig. 6; Bold, 1981, p. 78.
Costa aff. *bellipulex* Levinson. Breman, 1982, pl. 1, fig. J.
"*Costa*" *bellipulex* Levinson. Cronin, 1983, pl. 3, fig. A.

Diagnosis.—A three-ribbed, very evenly-reticulate species of *Costa* with a few enlarged fossae below the median ridge.

Holotype.—USNM 143787.

Type locality.—Exxon No. 2, OGS-G-1619 well, at 4120–4210 ft. Gulf of Mexico, due south of South Pass distributary of the Mississippi River.

Stratigraphic horizon.—Middle Pleistocene.

Dimensions.—HVH No. 10551 (left valve), L: 0.68; H: 0.21; HVH No. 10550 (right valve), L: 0.71; H: 0.21 (loc. NMB 16039).

Material.—Six adults, many molts.

Occurrence.—Río Gurabo section: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Pliocene to Recent: Jamaica, Hispaniola, Gulf of Mexico.

Genus **CATIVELLA** Coryell and Fields, 1937

Cativella navis Coryell and Fields
Plate 5, figure 4

Cativella navis Coryell and Fields, 1937, p. 9, pl. 1, fig. 9; Bold, 1946, p. 104, pl. 12, fig. 11; Bold, 1950, p. 85; Puri, 1954, p. 262, pl. 11, figs. 3–7, text-figs. 9i–k; Bold, 1958, p. 404, pl. 3, fig. 4; Bold, 1963a, table 6; Bold, 1963d, pp. 697, 698; Bold, 1964, table 2; Bold, 1966b, p. 7; Bold, 1966c, p. 14, tables 1, 2; Bold, 1966e, table 1; Bold, 1967a, table 1; Bold, 1967b, p. 311, pl. 1, fig. 5; Bold, 1968, tables 4, 10, 11; Rodríguez, 1969, p. 197, pl. 3, figs. 1, 3, text-fig. 12; Bold, 1970a, table 1; Bold, 1970b, table 4; Bold, 1971b, tables 3, 5; Bold, 1972a, tables 2, 3; Bold, 1973b, p. 334; Puri, 1974, pl. 5, figs. 8a, b; Bold, 1975a, tables 2, 3, 6, 7, 9–11; Bold, 1976, table 4; Bold, 1978b, tables 6–10; Bold, 1981, table 3.
Navecythere delicata Coryell and Fields, 1937, p. 7, pl. 1, figs. 7a–c [not *Pterygocythereis delicata* (Coryell and Fields). Swain, 1967, p. 47, pl. 3, figs. 3a, b, 4a–c, text-fig. 39 = prob. molt of *Cativella semitranslucens* (Crouch, 1949)].

Diagnosis.—A species of *Cativella* with the anterior rim continuing into the dorsal ridge.

Holotype.—AMNH 248931.

Type locality.—Cativa, Panama.

Stratigraphic horizon.—Gatun Formation (upper Miocene).

Reference material.—HVH No. 1871 (topotype).

Dimensions.—HVH No. 10814 (left valve), L: 0.70; H: 0.53 (loc. NMB 17010); HVH No. 10553 (right valve), L: 0.70; H: 0.41 (loc. NMB 17011).

Material.—More than 50 specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Middle Miocene to Recent: Caribbean, Gulf Coast.

Cativella species aff. **C. moriahensis** Bold

Cativella cf. *semitranslucens* (Crouch). Bold, 1957b, p. 243, pl. 2, fig. 6, table 1 [not *Cativella* aff. *semitranslucens* (Crouch). Bold, 1958, p. 404, pl. 3, fig. 3, table 1].
Cativella sp. aff. *C. moriahensis* Bold. Bold, 1970b, table 3 (part) [not table 4]; Bold, 1972a, table 3; Bold, 1981, p. 14, table 2.

Dimensions.—Carapace, L: 0.80; H: 0.44; W: 0.44 (Laguana amber site, No. 18).

Material.—One specimen.
Occurrence.—Laguana amber site: (Table 5).
Distribution.—Lower Miocene: Hispaniola, Trinidad (Quinam Quarry), Colombia (Goajira).

Genus **NEOCAUDITES** Puri, 1954

Neocaudites scottae Teeter
Plate 3, figure 14

Neocaudites nevianii (Edwards). Bold, 1971b, pl. 2, fig. 11; tables 3 (part), 4 [not *Cythereis nevianii* Edwards, 1944, p. 522, pl. 87, figs. 24–26].
Neocaudites scottae Teeter, 1975, p. 355, figs. 12j, 13k–m.
Neocaudites sp. Bold, 1975a, table 2; Bold, 1978b, table 1.

Diagnosis.—A finely-reticulate species of *Neocaudites.*
Holotype.—HVH No. 9012.
Type locality.—Loc. St. 320 of Teeter (1975), in 1.5 m of water near South Water Cay, Belize.
Stratigraphic horizon.—Recent.
Dimensions.—HVH No. 10556 (carapace), L: 0.45; H: 0.26; W: 0.20 (loc. NMB 16097).
Material.—Three specimens.
Remarks.—Cronin (written commun., 1985) believes that *Neocaudites scottae* Teeter is a junior synonym of *N. macertus* (Stephenson, 1944). In comparing the holotype of *N. macertus* (HVH No. 2299) with that of *N. scottae* (HVH No. 9012), I find that the first is more elongate and has a blunter anterior end, and *N. scottae* appears more coarsely reticulate, which also separates it from *N. subimpressus* (Edwards, 1944).
Occurrence.—Río Gurabo: Mao Formation (Table 2). Río Yaque del Norte (?Arroyo López): (Table 4).
Distribution.—Pliocene to Recent: Cuba, Dominican Republic, Costa Rica; Recent: Belize.

Genus **OCCULTOCYTHEREIS** Howe, 1951

Occultocythereis angusta Bold
Plate 5, figure 9

Cythereis deformis Brady, 1911, p. 597, pl. 20, figs. 6, 8 [not *Cythereis deformis* Baird, 1850, p. 256, pl. 16, figs. 4–6].
Occultocythereis angusta Bold, 1963b, p. 391, pl. 9, figs. 1a–c, pl. 12, fig. 6; Bold, 1966b, p. 5; Bold, 1966e, table 1; Bold, 1968, table 8; Bold, 1971b, tables 4, 6; Allison and Holden, 1971, p. 203, figs. 27a–f; Teeter, 1973, table 1; Maddocks, 1974, p. 212, pl. 7, figs. 5–6; Bold, 1975c, tables 2, 5; Teeter, 1975, p. 453, figs. 13f, 8, 14a; Bold, 1978b, table 9.

Diagnosis.—A two-ribbed species of *Occultocythereis* with heavy anterior rim and cuneiform dorsal view.
Holotype.—BM(NH) 1911-118. M 3334.
Type locality.—Off Madeira at 70 fathoms.
Stratigraphic horizon.—Recent.
Reference material.—USNM 684081.
Reference locality.—Loc. K 5121, Chaguaramas Bay, Trinidad.
Stratigraphic horizon.—Recent.
Material.—Eleven specimens.
Dimensions.—HVH No. 10557 (carapace), L: 0.51; H: 0.27; W: 0.21 (loc. NMB 16039).
Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).
Distribution.—Upper Miocene to Recent: Cuba, Jamaica, Dominican Republic, Trinidad, Costa Rica; Recent: off Madeira, Belize, Gulf of Mexico, Pacific Ocean (Clipperton Island).

Genus **PTERYGOCYTHEREIS** Blake, 1933

Pterygocythereis polita Bold
Plate 5, figure 10

Pterygocythereis polita Bold, 1968, p. 64, pl. 3, figs. 4a–c, pl. 9, figs. 4a, b, tables 6–8, 10; Bold, 1978b, table 9 (part).
?*Pterygocythereis hondurasensis* Teeter, 1975, p. 46, figs. 15n–p, 16a.

Diagnosis.—A species of *Pterygocythereis* with a continuous ridge forming the rim of the ventral alae, the anterior rim and the dorsal ridge, breaking off sharply at the posterior cardinal angle; ends heavily dentate, the anterior dentition continuing for a short distance along the ventral margin.
Holotype.—HVH No. 8357.
Type locality.—Loc. H 15299, on Santiago–Las Matas road, about 3.5 km west of La Bosua, Dominican Republic (Bold, 1968, text-fig. 5).
Stratigraphic horizon.—Gurabo Formation (Pliocene).
Dimensions.—HVH No. 10567 (left valve), L: 0.70; H: 0.40 (loc. NMB 17011).
Material.—Forty-five specimens.
Remarks.—*P. hondurasensis* Teeter is very similar, but appears to have the ala placed a little more towards the posterior.
Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).
Distribution.—Upper Miocene to Recent: Jamaica, Dominican Republic, Costa Rica; Recent: Belize?

Pterygocythereis llinasi, new species
Plate 5, figures 11, 12

Pterygocythereis miocenica Bold. Bold, 1968, tables 4–7, 9, 10 [not *Pterygocythereis miocenica* Bold, 1967b, p. 310, pl. 1, figs. 19a, b].

Etymology of name.—In honor of Romeo Llinas-Capellán, at the time of our fieldwork Director General de Minería, Dominican Republic.
Diagnosis.—A species of *Pterygocythereis* with a long, curved dorsal ridge in the left valve.
Holotype.—HVH No. 10564 (left valve).
Paratypes.—HVH No. 10565 (carapace), HVH No. 10566 (two left valves, two right valves).

Type locality.—Loc. NMB 15978.

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace alate, elongate subovate in side view, obliquely-rounded anteriorly, pointed below the middle posteriorly. Greatest height at about three-tenths of the length from the anterior extremity; greatest width at the end of the short, but wide alae, at about one-third of the length from the posterior extremity. Anterior end obliquely-rounded, bearing large and broad spines that continue a short distance along the ventral margin; ventral margin slightly sinuate; dorsal margin straight in the right valve, rather strongly convex in the left, forming a compressed ridge, and continuing with only a slight cardinal angulation into the posterior margin, which is slightly concave in the upper part. The ventral margin passes into the convex lower portion of the posterior margin and is finely spinose; at the posterior extremity a large spine occurs. Ventral surface flattened by a short, but wide ala, which possesses a flattened rim. Surface quite smooth. Just below the greatest height is a low but wide eye-tubercle.

Dimensions.—HVH No. 10565 (carapace), L: 0.78; H: 0.37; W: 0.52 (loc. NMB 15978).

Remarks.—This species occurs with *P. polita,* but differs by its curved dorsal margin of the left valve, where *P. polita* has a straight ridge.

Material.—Eleven specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Genus **PURIANA** Coryell and Fields *in* Puri, 1953b

Puriana gatunensis (Coryell and Fields)
Plate 5, figure 7

Cythereis rugipunctata (Ulrich and Bassler). Howe *et al.,* 1935, p. 23, pl. 1, figs. 18, 20–22, pl. 4, figs. 22, 23 [not *Cythere rugipunctata* Ulrich and Bassler, 1904, p. 118, pl. 38, figs. 16, 17].

Cythereis rugipunctata var. *gatunensis* Coryell and Fields, 1937, p. 10, pl. 2, fig. 11.

Favella puella Coryell and Fields, 1937, p. 8, pl. 1, fig. 8.

Favella rugipunctata (Ulrich and Bassler). Bold, 1946, p. 100, pl. 10, fig. 3; Bold, 1950, p. 86.

Puriana rugipunctata (Ulrich and Bassler). Puri, 1953b, p. 751; Puri, 1954, p. 257, pl. 12, figs. 18, 19, text-fig. 8k; Puri and Hulings, 1957, pp. 174, 176, 183; Bold, 1958, p. 404, pl. 3, fig. 2; Benson and Coleman, 1963, p. 43, pl. 8, figs. 1, 2, 5, text-fig. 27; Bold, 1963b, table 6; Bold, 1964, table 2; Bold, 1965b, p. 399, table 1; Hulings, 1966, p. 55, fig. 8i; Bold, 1966c, tables 1, 2; Bold, 1967b, p. 311, pl. 1, fig. 7; Grossman, 1967, p. 77, pl. 14, fig. 8, pl. 21, figs. 11–13; Hulings, 1967b, p. 654, fig. 7j; Bold, 1968, tables 4, 5 [not table 11]; Rodríguez, 1969, p. 195, pl. 3, figs. 7, 8, text-fig. 15; Puri and Vanstrum, 1969, pp. 73, 74, 76–78; Bold, 1970b, p. 40, tables 1, 4; Bold, 1971a, table 2; Bold, 1972a, tables 2, 3; Bold, 1978a, table 4; Bold, 1978b, tables 2, 8, 10; Gío-Argáez, 1982, p. 47, pl. 4, fig. 1; Machain-Castillo, 1982, p. 52.

Puriana puella (Coryell and Fields). Puri, 1954, p. 257, pl. 12, fig. 17 [not *Puriana* sp. aff. *P. puella* (Coryell and Fields). Bold, 1957b, p. 244, pl. 3, figs. 9a, b].

Puriana sp. Swain, 1955, p. 635, pl. 63, fig. 10; Krutak, 1971, p. 15, pl. 4, fig. 4a.

Puriana floridana Puri, 1960, p. 127, pl. 1, figs. 7, 8, text-figs. 20, 21; Valentine, 1971, pl. 2, figs. 32, 37; Cronin, 1979, p. 147, pl. 17, fig. 10.

Puriana gatunensis (Coryell and Fields). Bold, 1971b, tables 3, 5.

Puriana sp. aff. *P. rugipunctata* (Ulrich and Bassler). Bold, 1975c, table 5.

Puriana rugipunctata gatunensis (Coryell and Fields). Bold, 1971b, pl. 2, fig. 14; Bold, 1973a, table 1; Bold, 1973b, p. 334; Bold, 1975c, tables 2, 4; Bold, 1978b, table 9; Bold, 1981, pp. 102–104, 108, tables 2, 3, 14.

Puriana krutaki Kontrovitz, 1976, p. 70, pl. 4, figs. 9, 10.

Puriana cf. *krutaki* Kontrovitz. Krutak, 1982c, p. 367, pl. 6, figs. 15–17.

Diagnosis.—A small, elongate subquadrate species of *Puriana,* with irregular nodes, which are arranged in three to four vertical rows in the posterior part.

Holotype.—AMNH 24895.

Type locality.—Cativa, Panama.

Stratigraphic horizon.—Gatun Formation (upper Miocene).

Reference material.—HVH No. 1870 (topotype).

Dimensions.—HVH No. 10561 (left valve), L: 0.51; H: 0.16 (loc. NMB 16125).

Material.—About 30 specimens.

Remarks.—Comparison with material of *P. floridana* and *P. krutaki,* deposited in the H. V. Howe collections, has led me to conclude that they represent the same species as *P. gatunensis.* Cronin (written commun., 1985) points out that the inclusion of these species allows for a large variation in ornamentation of *P. gatunensis.* It is mainly a question of the size of the tubercles and not their location on the carapace, which is rather constant in all specimens. Therefore, I consider them, for the time being, as environmentally-induced variation. Cronin is at present making a study of the *Puriana rugipunctata* group, and if he can suggest a variation consistent with identifiable environments or geographic limits, I can accept these new forms as distinct subspecies or even species. However, so far I have not seen any regularity in their distribution. Although the species name *puella* was used by Puri (1954) prior to use of the name *gatunensis* (Bold, 1971b), I prefer to use the latter name, which was employed by Coryell and Fields for the adults of the species. The species *Favella puella* was established on the basis of immature individuals, so that the morphology of the holotype would not be representative of the genus if the specimen deposited as AMNH 24892 (holotype of *F. puella*) be accepted as the holotype.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper lower Miocene to Recent: Caribbean, Florida, Gulf Coast.

Puriana pustulosa Bold
Plate 5, figure 8

Puriana pustulosa Bold, 1968, p. 63, pl. 4, figs. 5a–c, pl. 5, figs. 6a, b, tables 9, 10.

Diagnosis.—A small species of *Puriana,* with irregular pustules, one very prominent at about one-fourth of the length from the posterior, just above the ventral margin.

Holotype.—HVH No. 8364.

Type locality.—Loc. H 15211, Río Mao in broad west bend of the river between Paso Jiménez and Paso Cercado (Bold, 1968, text-fig. 4).

Stratigraphic horizon.—Gurabo Formation (Pliocene).

Dimensions.—HVH No. 10562 (left valve), L: 0.41; H: 0.21 (loc. NMB 16964).

Material.—Eighteen specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Puriana scrupulosa Bold

Puriana scrupulosa Bold, 1968, p. 61, pl. 5, figs. 4a–c, pl. 9, figs. 5a, b, tables 5, 9, 10.

Diagnosis.—A species of *Puriana* with ruggedly spinose ornamentation; dorsal spines bladelike and deflected backwards.

Holotype.—HVH No. 8361.

Type locality.—Loc. H. 15437, Río Cana (Bold, 1968, text-fig. 3).

Stratigraphic horizon.—Gurabo Formation.

Dimensions.—HVH No. 10563 (left valve), L: 0.49; H: 0.26 (loc. TU 1446).

Material.—Twenty-seven specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Puriana species

Puriana sp. aff. *P. puella* (Coryell and Fields). Bold, 1957b, p. 244, pl. 3, figs. 9a, b [not *Favella puella* Coryell and Fields, 1937, p. 8, pl. 2, figs. 8a–c].
Puriana rugipunctata (Ulrich and Bassler). Bold, 1968, table 11 [not tables 4, 5] [not *Cythere rugipunctata* Ulrich and Bassler, 1904, p. 118, pl. 38, figs. 16, 17].
Puriana rugipunctata gatunensis (Coryell and Fields). Bold, 1981, tables 2, 3 [not table 14].

Dimensions.—HVH No. 10815 (carapace), L: 0.51; H: 0.26; W: 0.27 (loc. NMB 17186).

Material.—Four specimens.

Remarks.—As stated by Bold (1957b), the specimens from the Quinam, Morne Diablo and Ste. Croix quarries of Trinidad, differ from the younger species (*P. gatunensis*) by their almost unornamented posterior portion. The posterior cardinal angle is sharp and backwardly-deflected. This is also true for the specimens found in the Río Yaque del Norte (López) section.

Occurrence.—Río Yaque del Norte (López, Arroyo López): (Table 4).

Distribution.—Upper lower Miocene: Trinidad, Hispaniola.

Genus **AMBOCYTHERE** Bold, 1957c

Ambocythere exilis Bold
Plate 3, figure 15

Ambocythere exilis Bold, 1966b, pp. 5, 14, pl. 1, figs. 3–6, text-fig. 6; Bold, 1968, p. 64, tables 7, 12, 13; Bold, 1971b, p. 338, tables 3–5; Bold, 1972a, table 4; Bold, 1975a, table 13; Bold, 1978b, table 9; Bold, 1981, pp. 21, 53, 114, pl. 3, fig. 7, tables 14, 15 [not *Ambocythere exilis* Bold. Howe and Bold, 1975, pl. 1, fig. 3 (= *A. ramosa* Bold, 1966b)].

Diagnosis.—An elongate species of *Ambocythere* with a faint, irregular pattern of ridges and weak longitudinal costae.

Holotype.—HVH No. 7900.

Type locality.—Loc. H 15422, Río Gurabo.

Stratigraphic horizon.—Gurabo Formation (Pliocene).

Dimensions.—HVH No. 10568 (carapace), L: 0.51; H: 0.27; W: 0.18 (loc. NMB 16039).

Material.—Twenty-seven specimens.

Occurrence.—Río Cana: Mao Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene to Pleistocene: Dominican Republic, Haiti, Jamaica, Trinidad, Costa Rica.

Genus **ECHINOCYTHEREIS** Puri, 1954

Echinocythereis madremaestrae, new species
Plate 5, figures 14, 15

Cythereis dentata Müller. Bold, 1946, p. 90, pl. 10, figs. 21a, b [not *C. dentata* Müller, 1894].
Bosquetina sp. aff. *B. carinata* (Baird). Bold, 1967a, p. 79, pl. 1, fig. 16, pl. 2, figs. 7, 8; Bold, 1972a, p. 1041; Bold, 1973b, p. 153, table 1; Bold, 1978b, table 2.
Echinocythereis garretti (Howe and McGuirt). Bold, 1978b, table 1 (part) [not *Cythereis garretti* Howe and McGuirt *in* Howe *et al.*, 1935, p. 20, pl. 3, figs. 17–19, pl. 4, figs. 5, 15].
Echinocythereis sp. Bold, 1978b, table 9.
Echinocythereis, n. sp. Bold, 1983, p. 411, fig. 2.

Etymology of name.—In honor of the Universidad Católica Madre y Maestra, Santiago, Dominican Republic.

Diagnosis.—A species of *Echinocythereis* ornamented with very small tubercles, which in the ventral portion stand in convex downward rows; another row parallels the anterior margin.

Holotype.—HVH No. 10570 (left valve).

Paratypes.—HVH No. 10571 (right valve), 10572 (two left valves, one right valve).

Type locality.—Loc. NMB 15978, Río Gurabo.

Stratigraphic horizon.—Gurabo Formation (Pliocene).

Description.—Carapace in side view subovate, highest at the anterior cardinal angle, about three-tenths of the length from the anterior extremity and bearing a large, flat eye-node. Dorsal view spindle-shaped, widest about four-tenths of the length from the posterior extremity; both ends compressed with slightly concave sides. Anterior margin slightly obliquely-rounded in the left valve, almost regularly-rounded in the right, finely denticulate. Dorsal margin gently convex, ventral margin convex, slightly sinuate in front of the middle; posterior end angled below the middle, convex below, truncate above. Surface relatively smooth for the genus, only ornamented with rows of very small tubercles or papillae, which stand in more or less concentric rows, ventrally more convex than the ventral outline and paralleling the posteroventral curve of the margin. Slightly larger papillae form a row parallel to the anterior margin. Ventral surface flattened.

Marginal area very broad, crossed by 20 to 25 marginal pore canals and 15 to 20 false radial ones, which end in the anterior row of papillae. Selvage strongly developed, especially in the right valve. Hinge consists in the right valve of an anterior, elongate, somewhat bean-shaped tooth, and a slightly lobate posterior tooth. Median groove slightly widened anteriorly to accommodate a small, knoblike tooth at the anterior end of the median bar in the left valve. Anterior to this tooth is a large socket, surrounded by a heavy rim, which obscures the ocular sinus; posterior socket elongate-ovate. Muscle scars form a posterior row of four scars of which the second from above is elongate and slanted forward. Two frontal scars occur.

Dimensions.—HVH No. 10570 (left valve, holotype), L: 0.83; H: 0.56; HVH No. 10571 (right valve), L: 0.86; H: 0.55 (loc. NMB 15978); largest left valve, L: 0.90; H: 0.58 (loc. NMB 15978, No. 17); largest right valve, L: 0.90; H: 0.56 (loc. NMB 15978, No. 27).

Material.—Fifty-two specimens.

Remarks.—The papillae are smaller and more scattered than in most species of the genus [e.g., *E. echinata* (Sars) of Benson, Delgrosso, and Steineck, 1983, pl. 2, fig. 8], which have a less blunt, more obliquely-rounded anterior end.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Pliocene: Cuba, Dominican Republic, Trinidad, Panama, Costa Rica, Mexico.

Subfamily **BRACHYCYTHERINAE** Puri, 1954

Genus **BRACHYCYTHERE** Alexander, 1933

Brachycythere species aff. **B. russelli** Howe and Lea
Plate 6, figures 16–18; Text-figure 9

Brachycythere sp. cf. *russelli* Howe and Lea. Bold, 1968, p. 70.
Digmocythere sp. aff. *D. russelli* (Howe and Lea). Bold, 1975a, table 15.

Diagnosis.—A species of *Brachycythere* that differs from *B. russelli* Howe and Lea (*in* Howe and Law, 1936, p. 41, pl. 2, figs. 30, 31, pl. 3, figs. 23–25) by its more strongly arched dorsal margin and consequently by its wider accommodation groove in the left valve, and by a more posteriorly-oriented greatest height and width.

Holotype of B. russelli *Howe and Lea.*—HVH No. 1681.

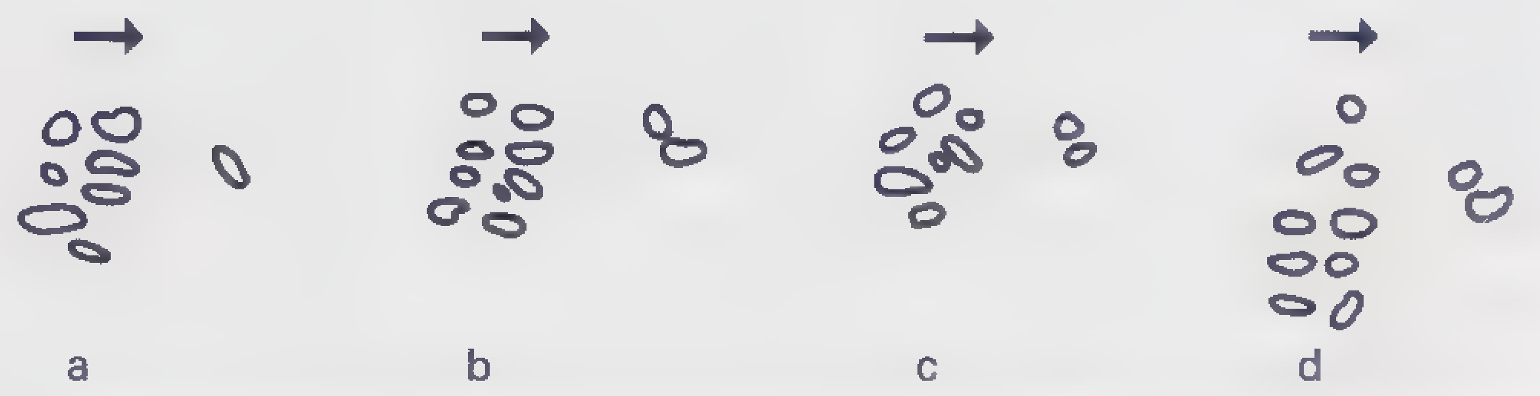
Type locality.—South bank of Sugar Creek, Catahoula Parish, Louisiana.

Stratigraphic horizon.—Vicksburg Group (Oligocene).

Dimensions.—HVH No. 10574 (right valve), L: 1.10; H: 0.72 (loc. TU 1292, Río Mao); HVH No. 10574 (left valve), L: 1.11; H: 0.78 (loc. TU 1292, Río Mao); HVH No. 10576 (carapace), L: 1.15; H: 0.80; W: 0.75 (loc. J 160, Buff Bay, Jamaica); HVH No. 10573 (right valve), L: 1.10, H: 0.70 (loc. NMB 15983).

Material.—About 80 specimens. The majority of specimens are immature molts.

Remarks.—The typical *B. russelli* (Bold, 1946, p. 107, pl. 13, figs. 8a–c; Bold, 1972b, p. 427, pl. 3, fig. 13; Hazel, Mumma, and Huff, 1980, pl. 5, fig. 3) has a range from late Eocene to early Miocene. *B.* sp. aff. *B. russelli* has a range from middle Miocene to Pliocene. As the two forms appear to form a gradation from one to the other, and it has not yet been established exactly how and where the change takes place, I prefer for the time being not to describe this form as a new species. The related modern form *B. mucronata* (Brady) (see Benson, Delgrosso, and Steineck, 1983, pl. 1, figs. 6, 7) differs by a pronounced flattening of the rim that forms the dorsal margin in the left valve. From the Eo-Oligocene to the Recent, this group of



Text-figure 9.—Muscle scars of *Brachycythere* species aff. *B. russelli* Howe and Lea, HVH No. 10574, loc. TU 1292, Gurabo Formation, Río Mao section. Note the variation from seven to nine scars in a single population. a. exterior of right valve; b. exterior of right valve; c. exterior of right valve; d. interior of left valve. Anterior side indicated by arrow.

forms appears to have migrated from a shallow to a deep marine environment. Therefore it is also not clear if the changes between the forms are environmentally induced or that they form a phylogenetic sequence.

The hinge of the present species shows in the right valve an elongate, curved, somewhat lobate, anterior tooth, very similar to that shown by Benson, Delgrosso, and Steineck (1983, pl. 3, fig. 1) for *B. mucronata.* At the posterior cardinal angle there is an elongate, crenulate tooth. The median groove merges with a round anterior socket. Adductor scars are very variably arranged. They tend to show a double row of four scars each, although sometimes only seven scars have been observed, and in one case there is an extra, round scar above the double row (Text-fig. 9). The frontal scar consists mostly of two individual scars, oblique to the more or less vertical trend of the adductor scars, but also here the shape and position are varying and in one case the two scars have fused, forming an indistinct V.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Middle Miocene (N 12 Zone) to Pliocene: Jamaica, Dominican Republic.

Subfamily **CAMPYLOCYTHERINAE** Puri, 1960

Genus **PROTEOCONCHA** Plusquellec and Sandberg, 1969

Proteoconcha? **evai**, new species
Plate 6, figures 1–4

Acuticythereis elongata Bold. Bold, 1968, p. 68, pl. 2, figs. 7a–d, tables 4–6, 9, 11; Bold, 1969, table 1; Bold, 1975c, pl. 18, fig. 13, table 4; Bold, 1981, p. 104 [not *Acuticythereis elongata* Bold, 1946, p. 106, pl. 12, figs. 4a–d].
Campylocythere? sp. Bold, 1975a, p. 563 (loc. M 33, text-fig. 12) [not p. 615, pl. 59, figs. 5a, b].
?*Acuticythereis elongata* Bold. Furrazola Bermúdez, Sánchez-Arango, García-Sánchez, and Bassov, 1978, p. 40 (table).

Etymology of name.—In honor of Anthony Eva, originally from England, at the time of our work in the Dominican Republic from Jamaica, at present working in Houston, Texas.

Diagnosis.—A species of the Campylocytherinae (tribe Campylocytherini) with a large anterior vestibule and narrow zone of concrescence, with a knoblike tooth with posterior platform and a round socket at the anterior side of a crenulate median groove in the right valve.

Holotype.—HVH No. 10577 (carapace, female).

Paratypes.—HVH No. 10578 (right valve), HVH No. 10579 (right valve), HVH No. 10580 (one left, and one right valve), HVH No. 10581 (three left, and three right valves).

Type locality.—Loc. NMB 16135, Río Gurabo.

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace smooth, elongate-ovate in side view, somewhat pointed behind; greatest height at about one-fifth of the length from the anterior extremity. Anterior margin slightly obliquely-rounded; dorsal margin almost straight, very slightly convex, almost parallel to the ventral margin, which is slightly sinuate; posterior margin obliquely-truncate above the middle, narrowly-rounded just below the middle, obliquely-truncate ventrally. The posterior end is sharply laterally-compressed ventrally from about one-eighth of the length from the posterior extremity backwards. Dorsal view lenticular, sides regularly and gently convex, both ends equal, narrowly-rounded. Left valve slightly larger than the right, overlapping along almost the entire margin. Surface smooth, normal, sieve-type pore canals numerous, rather evenly spaced over the entire valve.

Hinge amphidont. In the right valve, the anterior tooth rises rapidly from the selvage and forms a rounded knob, with a smaller lobe descending to a short platform between the anterior tooth and the anterior socket. The latter is rounded and connected to a slightly crenulate median groove, which narrows posteriorly, only to widen again just in front of its posterior termination. The posterior tooth is elongate, triangular and smooth in dorsal view, but slightly lobate, showing four distinct lobes in lateral view. In the left valve, an anterior, elongate socket is followed by a knoblike tooth with attached crenulate median bar and a posterior, elongate socket.

Marginal area of moderate width in the anterior end; line of concrescence close to and parallel to the outer margin; anterior vestibule large. Marginal pore canals are short and simple, stout, regularly spaced, about 13 in the area of the vestibule. In the posteroventral corner is a narrow and small vestibule with a few closely-spaced pore canals. Muscle scars consist of a posterior row of four adductor scars with two frontal scars and two fairly large mandibular scars.

Dimensions.—HVH No. 10577 (carapace, female, holotype), L: 0.84; H: 0.43; W: 0.38 (loc. NMB 16135); HVH No. 10579 (right valve, female), L: 0.80; H: 0.40 (loc. NMB 16135); HVH No. 10581 (left valve, female), L: 0.83; H: 0.43 (loc. NMB 17011); HVH No. 10581 (right valve, male), L: 0.83; H: 0.38 (loc. NMB 17011); HVH No. 10581 (left valve, male), L: 0.83; H: 0.41 (loc. NMB 17011); HVH No. 10581 (carapace, male), L: 0.83; H: 0.38; W: 0.37 (loc. NMB 17011).

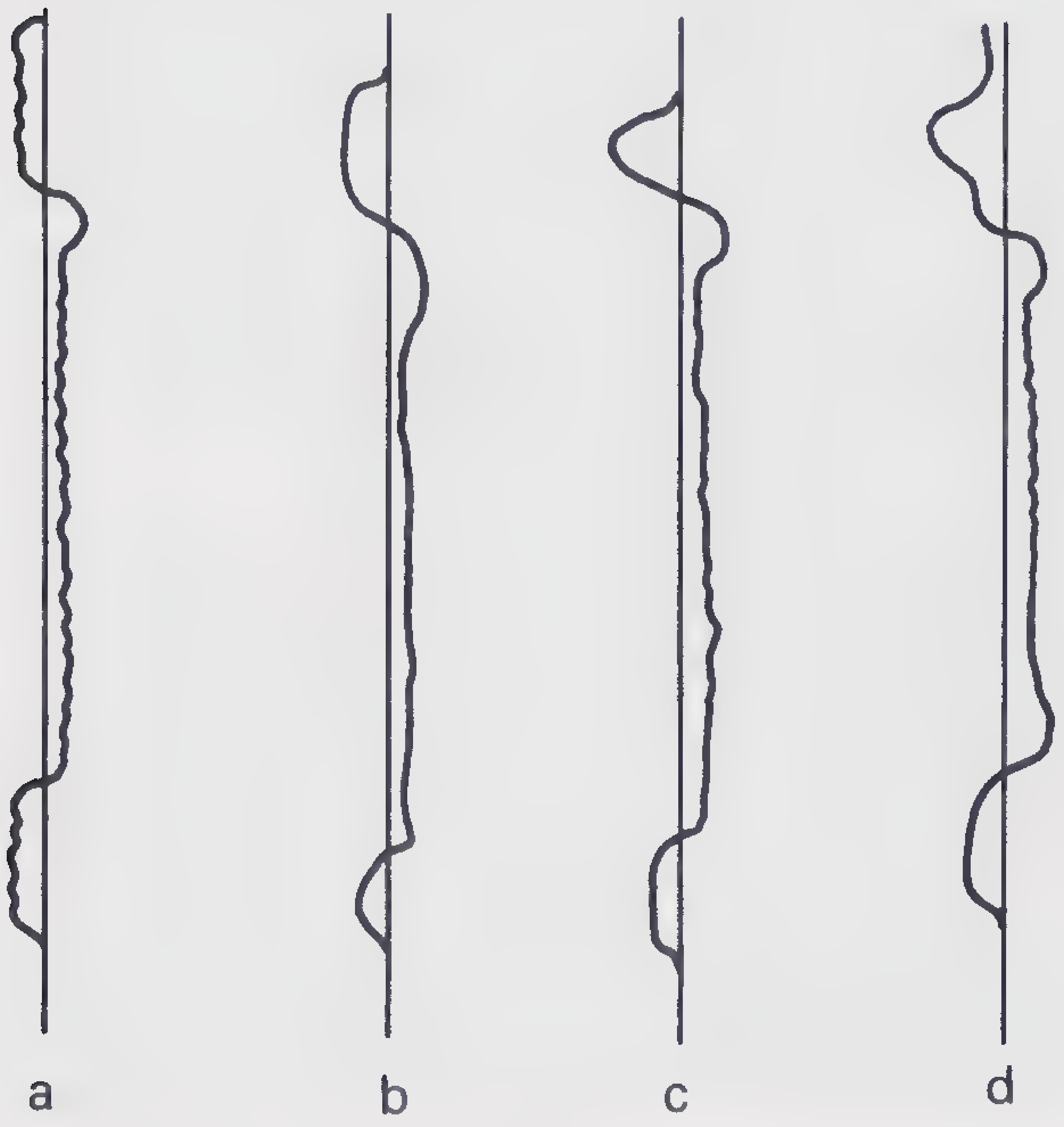
Material.—More than 180 specimens.

Remarks.—Although this species belongs with certainty to the Campylocytherini, there are slight discrepancies with the three genera recognized within this tribe, making it, at this stage, impossible to give a satisfactory generic assignment.

Acuticythereis Edwards, 1944, has a crenulate, elongate anterior tooth, a shallow postadjacent socket, a long, straight, crenulate groove, and a crenulate posterior toothplate (Plusquellec and Sandberg, 1969, p. 439, pl. 5, figs. 1, 2). According to them the hinge changes in modern specimens of *Acuticythereis laevissima* Edwards, 1944 to entomodont. *Campylocythere* Edwards, 1944, has a longer anterior hinge-element, long, narrow postadjacent socket, and a smaller posterior tooth. *Proteoconcha* has a steep-sided, conical, circular tooth, the posterior side of which slopes steeply into a circular socket, immediately posterior to the anterior tooth; the socket merges with a smooth or crenulate median groove; posterior tooth narrow, slightly longer than the anterior one, smooth to strongly crenulate. Text-figure 10 shows the different hinge types found in the Campylocytherini.

There are also some differences in the development of the marginal area. *Campylocythere* has a very narrow zone of concrescence with a wide vestibule and numerous pore canals. *Acuticythereis* has a wider zone of concrescence, a well-developed vestibule and the the line of concrescence is strongly indented at the beginning of the numerous pore canals. *Proteoconcha* has a shallow vestibule, a very irregular line of concrescence and both branching and simple marginal pore canals.

Whereas the hinge of *P.*? *evai* comes closest to that of *Proteoconcha,* the marginal area is somewhat more similar to that of *Campylocythere.* However both hinge and marginal area are distinctly different from all three genera. In view of the variation that Plusquellec and Sandberg allow in *Proteoconcha,* it appears reasonable to assign the present species questionably to that genus, rather than make it the type species of yet another genus of the Campylocytherini.



Text-figure 10.—Schematic dorsal view (anterior side at the top) of the hinge of a: *Acuticythereis* Edwards, 1944; b: *Campylocythere* Edwards, 1944; c: *Proteoconcha* Plusquellec and Sandberg, 1969; d: *Proteoconcha*? *evai,* n. sp.

This species was originally misidentified as *Acuticythereis elongata* Bold, which species has been figured for comparison: *Proteoconcha*? *elongata* (Bold) [Pl. 6, figs. 5 and 6]. Several badly-preserved specimens from the Dominican Republic and Haiti were originally identified as *A. elongata.* They are figured here for the first time: *Proteoconcha*? *elongata* (Bold)? from loc. M 26 in the Thomonde Formation, Comendador area, Dominican Republic (Pl. 6, fig. 9), and *Proteoconcha*? *elongata* (Bold)? from loc. K 534, north flank of Chamouscadille anticline, Haiti (Bold, 1981, p. 104, text-fig. 8) of the Las Cahobas Formation (Pl. 6, fig. 8).

Furrazola Bermúdez *et al.,* 1978 (correlation chart, part 1, p. 40), report *Acuticythereis elongata* from the upper Miocene (*Globorotalia acostaensis* Zone) of Cuba. I have not seen these specimens, but it appears very possible that they may turn out to be *Proteoconcha*? *evai.*

Occurrence.—Río Cana: Cercado, Gurabo, and Mao formations (Table 1). Río Gurabo: Cercado and Gurabo formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (López, Arroyo López, Santiago): (Table 4).

Distribution.—Upper Miocene and Pliocene: Greater Antilles.

Genus **CAMPYLOCYTHERE** Edwards, 1944

Campylocythere species
Plate 6, figure 7

Campylocythere sp. Bold, 1968, p. 68, pl. 2, figs. 8a–d.

Dimensions.—HVH No. 10582 (carapace), L: 0.77; H: 0.36; W: 0.28 (loc. NMB 16995).

Material.—Two specimens.

Occurrence.—Río Cana: Cercado Formation (Table 1).

Genus **CARIBELLA** Teeter, 1975

Caribella geisteri, new species
Plate 6, figures 10–13

"N. gen., n. sp." Bold, 1968, p. 82, pl. 4, fig. 2, pl. 10, fig. 3, tables 9, 11.
N. gen., sp. Bold, 1975c, table 4.
Nov. gen., nov. sp. Bold, 1968; Bold, 1975d, table 1.

Etymology of name.—In honor of Jörn Geister, Bern, Switzerland, companion in the Dominican Republic.

Diagnosis.—A small species of *Caribella,* subrectangular in outline, longitudinally-ribbed and reticulate.

Holotype.—HVH No. 10528 (carapace).

Paratypes.—HVH No. 8394 (one left valve, one right valve); HVH No. 10529 (left valve); HVH No. 10530 (right valve); HVH No. 10531 (right valve).

Type locality.—Loc. NMB 16964, Río Cana.

Stratigraphic horizon.—Gurabo Formation (?upper Miocene).

Description.—Carapace minute, subrectangular, about twice as long as high. Greatest height at anterior cardinal angle, about one-third of the length from the anterior extremity. Anterior margin evenly-rounded; dorsal margin straight, ventral margin almost straight, very slightly converging posteriorly; posterior margin bluntly angled in the middle, about straight above and below. Overlap of larger left valve strongest at the anterior cardinal angle. Surface relatively coarsely reticulate, longitudinal ridges more prominent with especially the dorsal and median ridge standing out. The inside of the fossae is minutely pitted. Dorsal view wedge-shaped, widest at one-fourth of the length from the posterior extremity. Posterior end compressed laterally.

Marginal area widest in the anterior end with a small vestibule; moderate number of marginal pore canals, slightly widened in the middle; some false radial canals occur. Hinge consists of an anterior tooth in the right valve, placed rather far backward, followed by a small socket that narrows to a small groove; posterior tooth more elongate and somewhat lobate. Adductor muscle scars form a vertical row of four with a V-shaped frontal scar.

Dimensions.—HVH No. 10528 (carapace, holotype), L: 0.34; H: 0.19; W: 0.16 (loc. NMB 16964).

Material.—Thirty-eight specimens.

Remarks.—This species is smaller than the type species, *Caribella puseyi* Teeter, 1975 (p. 461, pl. 14i, 15k–m) from Recent deposits off Belize (main lagoon), which species appears to be confined to Central America.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).

Distribution.—Upper Miocene to Pliocene: Cuba, Dominican Republic, Puerto Rico.

Caribella yoni (Puri)
Plate 6, figures 14, 15

Leptocythere yoni Puri, 1960, p. 114, pl. 4, figs. 8, 9.
"*Leptocythere*" *yoni* (Puri). Bold, 1972a, table 2.
Nov. gen. *yoni* (Puri). Bold, 1975c, table 5.
Basslerites yoni (Puri). Teeter, 1975, p. 360, figs. 14h, 15g.
Caribella yoni (Puri). Bold, 1978b, table 2.
Not n. gen. n. sp., aff. *Leptocythere yoni* Puri. Bold, 1978b, table 9 [= *Caribella puseyi* Teeter].

Diagnosis.—A species of *Caribella* with longitudinal arrangement of elongate and narrow fossae.

Holotype.—HVH No. 4740.

Type locality.—Bahia Honda, Florida Keys.

Stratigraphic horizon.—Recent.

Dimensions.—HVH No. 10532 (left valve), L: 0.41; H: 0.22; HVH No. 10533 (right valve), L: 0.42; H: 0.21 (loc. NMB 16978).

Material.—Twenty-six specimens.

Remarks.—Although Teeter did not include this species in his genus *Caribella* but assigned it to *Basslerites* Howe (*in* Coryell and Fields, 1937), the three known species are so closely related that I have no hesitation to place it in *Caribella.*

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Mao Formation (Table 2).

Distribution.—Upper Miocene to Recent: Dominican Republic, Venezuela; Recent: Gulf of Mexico, Belize, Cuba.

Family **CYTHERETTIDAE** Triebel, 1952

Genus **CYTHERETTA** Müller, 1894

Cytheretta dominicana (Bold)
Plate 5, figure 13

Paracytheretta dominicana Bold, 1968, p. 55, pl. 3, figs. 5a, b, pl. 9, fig. 2, tables 4–6, 10; Bold, 1975a, tables 8, 9; Bold, 1981, pp. 22, 110, table 15.
Cytheretta ponceana Bold. Bold, 1971b, p. 338, pl. 2, fig. 14, tables 4, 5; Bold, 1975c, table 4 [not *Cytheretta ponceana* Bold, 1969, p. 122, pl. 2, figs. 10a, b].

Diagnosis.—A reticulate, three-ribbed species of *Cytheretta,* with a strong anterior ridge and a median ridge that parallels the dorsal one in the posterior half of the carapace, but slants forward towards the ventral part of the anterior margin.

Holotype.—HVH No. 8347.

Type locality.—Loc. H 15296, on Santiago–Las Matas road, Dominican Republic (Bold, 1968, text-fig. 5).

Stratigraphic horizon.—Gurabo Formation.

Dimensions.—HVH No. 10569 (left valve), L: 0.67; H: 0.41 (loc. NMB 17011).

Material.—About 30 specimens.

Remarks.—*C. dominicana* and *C. ponceana* are very similar and only differ in the position of the median ridge, which is more oblique in *C. ponceana.*

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Pleistocene: Cuba, Jamaica, Hispaniola.

Cytheretta karlana Howe and Pyeatt

Cytheretta karlana Howe and Pyeatt, *in* Howe *et al.,* 1935, p. 34, pl. 1, figs. 30, 34, pl. 3, figs. 3, 4; Bold, 1946, p. 106, pl. 10, fig. 18; Swain, 1952, p. 46, pl. 6, fig. 19; Puri, 1954, p. 284, pl. 7, figs.

5, 6; Bold, 1963d, p. 697; Bold, 1968, p. 55, pl. 3, figs. 7a, b, table 11; Bold, 1975a, table 15; Bold, 1976, table 4; Bold, 1978b, tables 1, 2, 3, 10.

Paracytheretta karlana (Howe and Pyeatt). Puri, 1952a, p. 209, pl. 40, figs. 3–5, text-fig. 8.

Protocytheretta karlana (Howe and Pyeatt). Pooser, 1965, p. 38, pl. 12, figs. 3, 7–10; Gío-Argáez, 1982, pp. 47, 48, 107, pl. 4, fig. 13.

Protocytheretta choctawatcheensis (Howe and Taylor). Bold, 1973a, table 1 [not *Cytheretta karlana* var. *choctawatcheensis* Howe and Taylor, *in* Howe *et al.*, 1935, pl. 1, figs. 28, 29, 33].

Holotype.—HVH No. 1045.

Type locality.—Tenmile Creek, below bridge on the Marianna–Clarksville road, Calhoun County, Florida.

Stratigraphic horizon.—Chipola Formation (lower Miocene).

Dimensions.—HVH No. 15117 (carapace), L: 0.80; H: 0.44; W: 0.41 (loc. H 15117 of Bold, 1968, text-fig. 6).

Material.—Four specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4).

Distribution.—Middle to upper Miocene: Gulf Coast, Guatemala, Cuba, Hispaniola.

Family **LOXOCONCHIDAE** Sars, 1925

Genus **LOXOCONCHA** Sars, 1866

Species of the Loxoconchidae form such a closely-related group, that I here consider such genera as *Loxocorniculum* Benson and Coleman, 1963, *Palmoconcha* Swain and Gilby, 1974, *Sagmatocythere* Athersuch, 1976, and *Touroconcha* Ishizaki and Gunther, 1976, as subgenera of the genus *Loxoconcha.* It should be noted that *Palmoconcha* appears to be restricted to soft-bottom sediments, usually of deeper-water environment, whereas all known species of *Loxocorniculum* are more or less restricted to carbonate environments of shallow water.

Subgenus **LOXOCONCHA** Sars, 1866

Loxoconcha (Loxoconcha) forda Bold

Plate 7, figures 1, 2

Loxoconcha forda Bold, 1968, p. 70, pl. 3, figs. 3a–c, tables 4, 6, 8, 9, 11; Bold, 1969, table 1; Bold, 1971b, tables 3–5; Bold, 1975c, table 4; Bold, 1975d, table 1; Sánchez-Arango, 1977, p. 23, fig. 2; Kusnetzov *et al.*, 1977, p. 53; Bold, 1981, p. 81, pl. 5, figs. 11a, b, table 15.

Not *Loxoconcha forda* Bold. Herrig, 1977, p. 1260, pl. 2, fig. 5; Hanai, Ikeya, and Yajima, 1980, p. 189.

Diagnosis.—A subquadrate to subcircular species of *Loxoconcha* that has its greatest width just below the center of the valves, around which is a concentric pattern of reticulation.

Holotype.—HVH No. 8341.

Type locality.—Loc. H 15469, on Mao–Santiago Rodríguez road, 3 km W of the bridge over the Gurabo river (Bold, 1968, text-fig. 3).

Stratigraphic horizon.—Gurabo Formation.

Dimensions.—HVH No. 10583 (left valve), L: 0.51; H: 0.37 (loc. NMB 16178).

Material.—About 50 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene and Pliocene: Greater Antilles.

Loxoconcha (Loxoconcha) spinoalata Bold

Plate 7, figures 3, 4

Loxoconcha spinoalata Bold, 1946, p. 111, pl. 15, fig. 14; Bold, 1973b, table 1.

Loxoconcha sp. aff. *L. spinoalata* Bold. Bold, 1975c, table 4.

Diagnosis.—A subquadrate to subcircular species of *Loxoconcha* that has a bladelike spine just below the center of the valves.

Holotype.—GIRU S 13058.

Type locality.—Loc. W 206, outcrop on northern trail from Victoria de las Tunas to Vásquez, West Oriente, Cuba.

Stratigraphic horizon.—Basal Paso Real Formation [or Arabos Member of the Güines Formation] (lower Miocene).

Description.—Carapace in side view subquadrate to subcircular. Anterior end very blunt with almost straight dorsal slope; dorsal margin straight, ventral margin convex and broadly curving upward towards the posterior end, which is situated at about one-third of the height from the posterior cardinal angle and forms a short caudal process. Surface deeply pitted. A narrow ridge runs almost parallel to the ventral and posteroventral margin; above this ridge lies a bladelike lateral spine beginning at about two-fifths of the length from the anterior extremity and ending abruptly at about two-thirds of the length.

Dimensions.—HVH No. 10584 (left valve), L: 0.46; H: 0.32 (loc. NMB 16135).

Material.—Thirty-seven specimens.

Remarks.—The material from the Cibao Valley consists of much smaller specimens than those from the lower Miocene of Cuba (L: 0.64) and from the Bayaguana and Laguana amber sites (south side of the Cordillera Central in the eastern Dominican Republic) (L: 0.57), or from the La Cruz Formation of Santiago de Cuba (L: 0.56). However, the overall similarity is such that at present no attempt is made to separate them.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4). Bayaguana and Laguana amber sites: (Table 5).

Distribution.—Lower Miocene to Pliocene: Cuba, Dominican Republic.

Loxoconcha (Loxoconcha) runa Bold
Plate 7, figures 13–15

Loxoconcha antillea var. *oblongata* Bold, 1946, p. 110 (part) [not pl. 15, fig. 5 = *L. antillea* Bold (male)].
Loxoconcha runa Bold, 1970b, p. 47, pl. 1, figs. 9a–d; Bold, 1972b, p. 430; Bold, 1978b, table 7; Bold, 1981, p. 81, pl. 5, figs. 5a, b, tables 2, 4.
Loxoconcha antillea var. Bold, 1971a, table 1.

Diagnosis.—A slender species of *Loxoconcha* with several thin longitudinal ridges in the ventral part, one of which may become strongly alate just behind the middle.

Dimensions.—HVH No. 10737 (left valve), L: 0.48; H: 0.27; W: 0.30 (loc. NMB 17189).

Material.—Ten specimens.

Remarks.—*L.* (*L.*) *runa* has many characters in common with species of the genus *Sagmatocythere* Athersuch, 1976, which I should consider as another subgenus of *Loxoconcha,* but lacks the rather strong posteroventral alation.

Occurrence.—Río Yaque del Norte (Baitoa, López): (Table 4). Bayaguana amber site: (Table 5).

Distribution.—Lower to lower middle Miocene: Paso Real Formation: Cuba; Anguilla Formation: Lesser Antilles; Jealousy Formation: St. Croix; La Boca Formation: Panama; lower Miocene: Costa Rica.

Subgenus **PALMOCONCHA** Swain and Gilby, 1974

Loxoconcha (Palmoconcha) banesensis Bold
Plate 7, figures 5–7

Loxoconcha banesensis Bold, 1946, p. 112, pl. 15, figs. 11a, b; Bold, 1957b, p. 245, pl. 4, fig. 13; Bold, 1958, table 1; Bold, 1963b, table 7; Bold, 1964, table 2; Bold, 1966a, table 1; Bold, 1966b, p. 7; Bold, 1967b, pl. 1, fig. 9, table 1; Bold, 1968, pl. 3, figs. 4a, b, tables 7, 8, 11; Bold, 1970a, p. 40, table 1; Bold, 1971a, table 2; Bold, 1971b, tables 3, 5; Bold, 1972a, tables 2–4; Bold, 1973a, table 1; Bold, 1975a, table 11; Sánchez-Arango, 1977, table 2; Bold, 1981, p. 82, pl. 5, figs. 4a, b, tables 2, 3, 5–8, 10, 14, 15.
Loxoconcha aff. *banesensis* Bold. Bold, 1966b, p. 5; Bold, 1978b, tables 1, 9.
?*Loxoconcha* aff. *banesensis* Bold. Hulings, 1967b, p. 650, figs. 4d, e, 6g.
Loxoconcha aff. *cubensis* Bold. Lubimova and Sánchez-Arango, 1974, pl. 16, figs. 5, 5a.

Diagnosis.—A species of *Palmoconcha* with two pronounced ventral keels, and a convex dorsal margin in the left valve.

Holotype.—GIRU S 13059.

Type locality.—Loc. T 1451, outcrop on shore of Bahia de Nipe, just west of Antilles, Oriente Province, Cuba.

Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (Júcaro Formation of Kozary, 1957, Jakus, 1983, p. 62).

Dimensions.—HVH No. 10586 (right valve), L: 0.43; H: 0.26; HVH No. 10588 (carapace), L: 0.43; H: 0.27; W: 0.23 (loc. NMB 15979).

Material.—More than 140 specimens.

Remarks.—Species of *Palmoconcha* (such as *P. laevimarginata* Swain and Gilby, 1974, p. 325, pl. 5, figs. 10–13; *P. minima* Ishizaki and Gunther, 1976, p. 22, pl. 3, figs. 1, 2, 6–8, 13, text-fig. L. 3; *L.* (*P.*) *polugari* Finger, 1983, p. 100, pl. 1, figs. 8–11; *L. wagneri* Bold, 1960, p. 173, pl. 7, figs. 4a, b; *L.* sp. A of Bold, 1981, p. 83, pl. 5, figs. 1a, b) all have ventral keels, which are probably an adaptation to soft bottoms. These species are generally outer neritic to bathyal.

Occurrence.—Río Cana: Gurabo and Mao formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Lower Miocene to Recent: Caribbean.

Subgenus **LOXOCORNICULUM**
Benson and Coleman, 1963

In previous publications, I have rejected the genus *Loxocorniculum* because its separation from true *Loxoconcha* appears artificial. There are apparently closely-related forms with and without dorsal tubercles, some with straight and some with curved dorsal margins. Here I want to accept *Loxocorniculum,* as a subgenus of *Loxoconcha,* forming a group of tropical and subtropical shallow-water species, mostly with a preference for carbonate substrates.

Benson and Coleman (1963) gave the following diagnosis for *Loxocorniculum*:

> Loxoconchid in shape; moderately to coarsely reticulate with horn-like protuberance on posterodorsum; hinge gongylodont.

There has been a proliferation of species in this genus because: 1. Some authors have disregarded the "moderate to coarsely reticulate" of the diagnosis and included almost smooth or slightly pitted forms; 2. Under slightly changing ecological conditions the size of the tubercles may change considerably. A first inkling of this was perceived by Bold (1946), when he distinguished five varieties of *Loxoconcha antillea* Bold: the "normal" form, *nodosa, oblongata* (in part males), *rugosa* (exaggerated tubercles), and *pteryga* (large ventral tubercle), and tried to relate the amount of ornamentation to water chemistry and substrate (Bold, 1946, p. 48).

In order to eliminate species added to the genus under 1, I want to emend the diagnosis as follows: A subgenus of *Loxoconcha* with the same characteristics as the genus except: a. presence of a posterodorsal tubercle; b. moderately to strongly reticulate; c. dorsal margin straight in both sexes; d. anterior end rather

angular, with two short, forwardly-diverging ridges, the upper one of which meets the anterior margin at the upper angulation, about median height.

The presence of an eye-tubercle and one of two posteroventral tubercles or ridges can be used to subdivide the subgenus into groups of species: 1. eye-tubercle and two posteroventral tubercles: *L. lienenklausi* Bold, 1961, *L. antillea* Bold, 1946, *L. fischeri* (Brady, 1869) (Oligocene to Recent, Caribbean) (Pl. 7, figs. 9, 10); also *L. longispina* Keij, 1953 (Recent, Indopacific). 2. Eye-tubercle and one posteroventral tubercle: *Loxocorniculum tricornatum* Krutak, 1971 (Pl. 7, fig. 8). 3. Eye-tubercle only: *L. dorsotuberculata* (Brady, 1866) (upper Miocene to Recent) (Pl. 7, fig. 11).

The emended diagnosis would exclude such species as *L. matagordensis* Swain, 1955, *L. purisubrhomboidea* Edwards, 1944, *L. lenticuloides* Swain and Gilby, 1974, *L. occidentale* Bate, Whittaker, and Mayes, 1981, which are closer to true *Loxoconcha* (*L. rhomboidea* group) [see also Bate, Whittaker and Mayes, 1981, p. 52]. It would also exclude such species as *L. runa* Bold (Pl. 7, figs. 13–15) and *L. spinoalata* Bold, 1946 (Pl. 7, figs. 3, 4) which have straight dorsal margins and posteroventral ridges, but lack a prominent posterodorsal tubercle, although posterodorsal ridges may be present, and also lack the anterior ridges.

Loxoconcha (Loxocorniculum) dorsotuberculata (Brady)

Plate 7, figure 11

Normania dorsotuberculata Brady, 1866, p. 383, pl. 61, figs. 14a–c [not figs. e–g].

Loxoconcha dorsotuberculata (Brady). Tressler, 1954, p. 435; Bold, 1966c, table 1; Bold, 1966d, p. 51, pl. 3, figs. 3a, b; Bold, 1968, tables 4–6, 9, 10; Bold, 1971b, tables 1–5; Bold, 1972a, table 2; Bold, 1973b, p. 334; Lubimova and Sánchez-Arango, 1974, pl. 16, figs. 7, 7a; Bold, 1975a, tables 2, 3, 8, 11; Bold, 1975c, tables 2, 5; Bold, 1978b, table 9; Bold, 1981, p. 81.

Loxoconcha sp. 1. Baker and Hulings, 1966, p. 114, pl. 1, fig. 12.

Not *Loxoconcha dorsotuberculata* (Brady). Bold, 1946, p. 111; Bold, 1960, p. 901; Bold, 1963a, p. 696; Teeter, 1975, p. 478, figs. 19n, o, 20a [= *Loxoconcha* (*Loxocorniculum*) *tricornata* (Krutak, 1971)].

Diagnosis.—A species of *Loxocorniculum* with posterodorsal tubercle only.

Holotype.—Hancock Museum, Newcastle-upon-Tyne, England, U. K.

Type locality.—"West Indies".

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 8263.

Reference locality.—Loc. P 16, Colón Harbor, Panama (Bold, 1966d).

Stratigraphic horizon.—Recent.

Dimensions.—HVH No. 8263 (right valve), L: 0.61; H: 0.38 (loc. P 16, Panama, Recent); HVH No. 10592 (left valve), L: 0.46; H: 0.29 (loc. NMB 16985).

Material.—Twenty-five specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).

Distribution.—Upper Miocene to Recent: Greater Antilles, Venezuela, Colombia, Costa Rica; Recent: Caribbean, Gulf of Mexico.

Loxoconcha (Loxocorniculum) fischeri (Brady)

Plate 7, figures 9, 10

Cythere fischeri Brady, 1869, p. 154, pl. 16, figs. 15, 16.

Loxoconcha fischeri (Brady). Bold, 1963b, p. 393, pl. 8, figs. 8, 9; Bold, 1964, table 2; Bold, 1966b, p. 5; Bold, 1966c, tables 1, 2; Bold, 1966d, p. 51, pl. 3, fig. 7; Bold, 1966e, table 1; Bold, 1967b, table 1; Hulings, 1967b, p. 650, fig. 6g; Bold, 1968, tables 4, 6, 9, 10; Bold, 1969, table 1; Bold, 1971b, tables 2–6; Bold, 1972a, tables 2, 3; Bold, 1973a, table 1; Bold, 1973b, p. 334; Bold, 1975a, table 12; Bold, 1975c, tables 2, 4; Bold, 1975d, table 1; Teeter, 1975, p. 447, figs. 18h, 19f; Bold, 1978b, tables 8, 9.

Loxocorniculum fischeri (Brady). Benson and Coleman, 1963, p. 39, pl. 7, fig. 4 [not fig. 3, text-figs. 24a–c]; Ishizaki and Gunther, 1976, p. 18, pl. 2, figs. 9–12, pl. 4, fig. 1.

Loxoconcha magna Teeter, 1975, p. 477, figs. 19j–m, 20e [not *L. magna* Stancheva, 1972, p. 103, pl. 3, fig. 1; not *L. megapora magna* Hartmann, 1974, p. 299, pl. 66, figs. 498–507 (= ?*L. megapora* Benson and Maddocks, 1964)].

Not *Loxoconcha fischeri* (Brady). Bold, 1957b, p. 224, pl. 2, fig. 7; Bold, 1958, table 1 [= *Loxoconcha antillea* Bold, 1946]; Kontrovitz, 1978, p. 146, pl. 4, fig. 4.

Diagnosis.—A species of *Loxocorniculum* with two posteroventral tubercles.

Holotype.—Hancock Museum, Newcastle-upon-Tyne, England, U. K. (Bold, 1963b, pl. 8, fig. 9).

Type locality.—Colón Harbor, Panama.

Stratigraphic horizon.—Recent.

Reference material.—HVH No. 8264.

Reference locality.—Loc. P 16, Colón Harbor, Panama (Bold, 1966d).

Dimensions.—HVH No. 10591 (left valve, female), L: 0.55; H: 0.34; HVH No. 10590 (right valve, male), L: 0.57, H: 0.32 (loc. NMB 17011).

Material.—More than 200 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene to Recent: Greater Antilles, Trinidad, Venezuela, Colombia, Panama, Costa Rica, Mexico.

Loxoconcha (Loxocorniculum) tricornata (Krutak)

Plate 7, figure 8

Normania dorsotuberculata var. Brady, 1866, p. 383, pl. 61, figs. 14e–g [not 14a–c].

Loxocorniculum fischeri (Brady). Benson and Coleman, 1963 (part), text-figs. 21a–c.

Loxocorniculum tricornatum Krutak, 1971, p. 20, pl. 3, figs. 1a–c; Krutak and Rickles, 1979, p. 269, pl. 1, figs. 8–13, tables 2, 3, text-fig. 4; Krutak, 1982c, p. 273, pl. 4, figs. 7–12.
Loxoconcha oculocrista Teeter, 1975, p. 479, figs. 20d, 21a–c.
Loxoconcha suboculocrista Teeter, 1975, p. 479, figs. 20b, 21d–f.

Diagnosis.—A species of *Loxocorniculum* with one posteroventral tubercle.

Holotype.—HVH No. 9046.

Type locality.—Station 4 of Krutak (1971), Laguna Mandingo, Mexico.

Stratigraphic horizon.—Recent.

Reference material.—HVH Nos. 9038–9041.

Reference locality.—Belize.

Stratigraphic horizon.—Recent.

Dimensions.—HVH No. 10589 (left valve), L: 0.56; H: 0.36 (loc. NMB 16103).

Material.—Five specimens.

Remarks.—Comparison of the type material of Krutak and Teeter in the HVH collections shows that there are only very slight differences between the material from Mexico and Belize, which are probably indicative of minor environmental changes.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Miocene and Pliocene: Dominican Republic; Recent: Gulf of Mexico, Belize.

Loxoconcha (Loxocorniculum) antillea Bold

Loxoconcha antillea Bold, 1946, p. 110, pl. 13, figs. 3a–c; Bold, 1965b, p. 402, pl. 4, figs. 3a, b; Bold, 1968, table 11; Bold, 1970b, tables 1, 3; Bold, 1971a, table 2; Bold, 1972a, table 2; Bold, 1972b, p. 430, tables 2, 4; Bold, 1973a, table 1; Bold, 1975d, table 4; Bold, 1978b, table 3; Bold, 1981, tables 3, 10; Steineck, 1981, table 2; Steineck *et al.*, 1984, fig. 5; Bold, 1982, tables 2, 3, 4.
Loxoconcha fischeri (Brady). Bold, 1957b, p. 244, pl. 2, fig. 7; Bold, 1958, table 1 [not *Cythere fischeri* Brady, 1869, p. 154, pl. 18, figs. 15, 16].

Holotype.—GIRU S 13053.

Type locality.—Loc. W 206, West Oriente Province, Cuba (Bold, 1946, p. 127; Bold, 1973a, p. 1480).

Stratigraphic horizon.—Paso Real Formation (lower Miocene).

Dimensions.—HVH No. 10791 (carapace), L: 0.49; H: 0.28; W: 0.31 (Laguana amber site).

Material.—Seven specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4). Laguana amber site: (Table 5).

Distribution.—Lower to upper Miocene: Caribbean.

Loxoconcha (Loxocorniculum) rugosa Bold

Loxoconcha antillea var. *rugosa* Bold, 1946, p. 110, pl. 15, figs. 6a, b.
Loxoconcha rugosa Bold. Bold, 1957b, p. 244, table 1; Bold, 1963b, p. 394, pl. 8, fig. 7; Baker and Hulings, 1966, p. 122, pl. 2, fig. 11; Bold, 1968, tables 7, 9, 11, 12; Bold, 1970b, table 3; Bold, 1972a, table 2; Bold, 1975c, tables 4, 8; Bold, 1978b, table 9; Bold, 1981, p. 81, pl. 5, fig. 8, table 15; Breman, 1982, p. 237.

Holotype.—GIRU S 13057 (Bold, 1946, pl. 15, figs. 6a, b).

Type locality.—Loc. T 1451, outcrop on shore of Bahia de Nipe, west of Antilles, Oriente Province, Cuba (Bold, 1973a, p. 148).

Stratigraphic horizon.—Júcaro Formation of Kozary (1957) [in Jakus, 1983, p. 62] (upper Miocene).

Dimensions.—HVH No. 10792 (left valve), L: 0.57; H: 0.41 (loc. NMB 17189).

Material.—Five specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4).

Distribution.—Lower Miocene to Recent: Caribbean.

Subgenus **TOUROCONCHA**
Ishizaki and Gunther, 1976

Loxoconcha (Touroconcha) lapidiscola Hartmann?
Plate 7, figure 12

?*Loxoconcha lapidiscola* Hartmann, 1959, p. 223, pl. 41, figs. 128–129, pl. 42, figs. 131–133; Bold, 1966d, p. 51, pl. 4, figs. 8a, b; Swain and Gilby, 1974, p. 324, pl. 5, figs. 9a, b; text-fig. 24; Bold, 1978b, table 9.
Loxoconcha lapidiscola Hartmann. Bold, 1963b, p. 394, pl. 8, fig. 6.
Not *Loxoconcha lapidiscola* Hartmann. Swain, 1969, p. 469, pl. 6, figs. 6a, b, pl. 11, fig. 11.
?*Touroconcha lapidiscola* (Hartmann). Ishizaki and Gunther, 1976, p. 20, pl. 1, fig. 10, pl. 3, figs. 10, 11; Bate, Whittaker, and Mayes, 1981, p. 48, figs. 30I–L, 31G, H, 32A.

Diagnosis.—A species of *Touroconcha* with an ornamentation reminiscent of *Kangarina* Coryell and Fields, 1937. The posteroventral reticulum has a smooth or only very slightly irregular lower ridge.

Reference material.—HVH No. 6875.

Reference locality.—Biche Quarry, Trinidad.

Stratigraphic horizon.—Upper Miocene.

Dimensions.—HVH No. 10593 (left valve), L: 0.45; H: 0.27 (loc. NMB 16995).

Remarks.—Bate, Whittaker, and Mayes (1981) considered *L. lapidiscola* of Bold (1963b) as different from Hartmann's species because of the absence of an indentation in the posteroventral reticulum. This indentation is absent in most of the Caribbean material, although there are occasional female specimens with a very weak indentation (Pl. 7, fig. 12). All the males and all molts show a perfectly smooth border of the ventral side of the reticulum. This Caribbean form does not change from the late Miocene form throughout the Pliocene and is still the same in Recent material. However, in the Río Banano Formation of the Limón Basin (Costa Rica) and in Recent material from Colón Harbor (Panama), the posteroventral ridge is indented or even interrupted in the females, but is

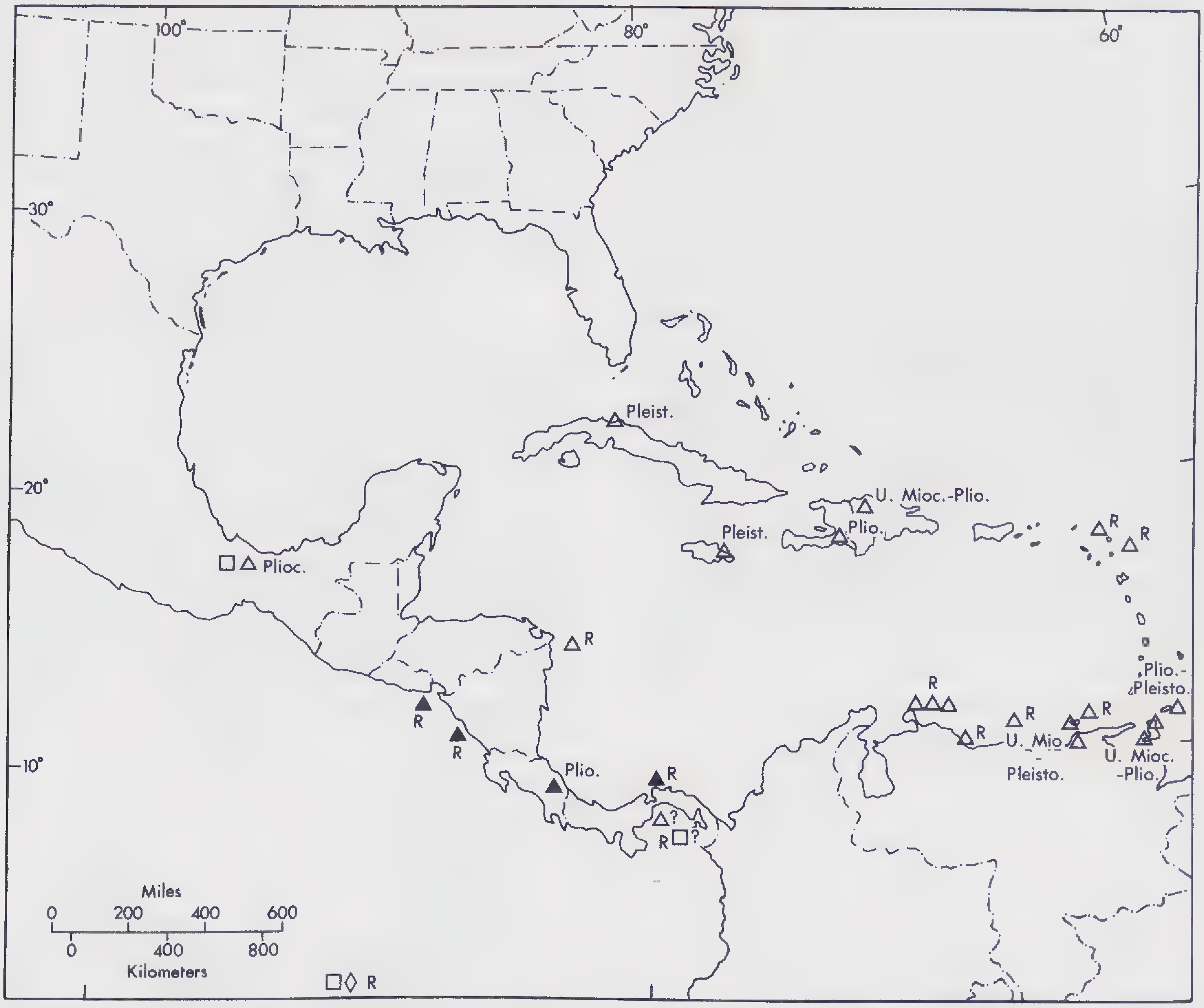
smooth in males and molts. This indentation is also absent in Swain and Gilby's male specimen (1974, pl. 5, fig. 9a) and in the male *T. lapidiscola* of Ishizaki and Gunther (1976, pl. 3, fig. 9). On the other hand, the form figured by Bate, Whittaker, and Mayes (1981, figs. 3I, J, M) from the Galapagos shows an indentation in both males and females. If Bate, Whittaker, and Mayes are right, we may have three different subspecies of *L.* (*T.*) *lapidiscola*: a Central American form (with indentation in the female only); a Caribbean form (without indentation), and a Galapagos form (with indentation in both male and female). However, the difference is very slight and could easily be produced by adaption to different substrates.

Molts of the Caribbean form show a remarkable similarity to *T. mosquera* Bate, Whittaker, and Mayes, 1981 (p. 45, figs. 31a–f, i–n, 32d, 33a), and adults of the same ornamentation have been found in the Agueguexquite Formation (Pliocene) of Mexico. These show the more pronounced secondary reticulum of the two male specimens described by Bate, Whittaker, and Mayes (1981). Also the male left valve figured by Ishizaki and Gunther (1976, pl. 3, fig. 9) is very similar to *T. mosquera,* but the female right valve (pl. 3, fig. 10) appears identical to that of the Caribbean form. In view of the minor morphological differences of the four forms involved, I prefer to treat them as a single species and consider the minor inconsistencies as environmentally-induced. Later studies may decide whether different subspecies can be recognized. At present the distribution of the three forms of *L.* (*T.*) *lapidiscola* (Text-fig. 11) is not quite consistent with the idea of geographic subspecies.

Material.—About 20 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene to Recent: Mexico, Cuba, Jamaica, Hispaniola, Trinidad, Barbados, Venezuela; Recent: Antigua, north coast of Venezuela,



Text-figure 11.—Distribution of *Loxoconcha* (*Touroconcha*) Ishizaki and Gunther, 1976, in the Caribbean and the Pacific coast of Central America. R = Recent; □ = *L.* (*T.*) *mosquera*; △ = *L.* (*T.*) *lapidiscola,* Caribbean form; ▲ = *L.* (*T.*) *lapidiscola,* Central American form; ◇ = *L.* (*T.*) *lapidiscola,* Galapagos form. See above for discussion of the three forms of *L.* (*T.*) *lapidiscola.*

Miskito Keys (Nicaragua). The fossil occurrences are generally of one or two specimens, rarely up to 10, and the Recent ones show much the same (Hartmann reported nine specimens, Swain and Gilby two, Ishizaki and Gunther over 20). I have found only one abundant occurrence, on the beach of Chichiriviche (Falcón, Venezuela) with 28 females, 13 males and 12 molts.

Genus **PHLYCTOCYTHERE** Keij, 1958

Phlyctocythere curva, new species
Plate 12, figures 19, 20, Text-figure 12

Etymology of name.—(L.) *curvus* = bent [because of the sinuous dorsal outline].

Diagnosis.—A species of *Phlyctocythere* with strongly sinuous dorsal margin and a faint reticulate pattern in the anterior part of the valves.

Holotype.—HVH No. 10600 (right valve).

Paratypes.—HVH No. 10601 (left valve); HVH No. 10602 (carapace, five right valves, two left valves).

Type locality.—Loc. NMB 16156 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation, calcareous siltstone, about 80 m above the base.

Description.—Carapace irregularly ovate, highest just in front of the middle; shell very thin and fragile. Anterior margin slightly obliquely-rounded; dorsal margin sinuous, convex in front of the middle, concave in the posterior half; ventral margin slightly concave in front of the middle, curving upward into the posterior margin. Posteroventral margin sharply keeled. Posterior end situated slightly above the middle, somewhat turned upward in a pronounced caudal process. The posteroventral keel is obliquely truncate and straight from the posterior end to a blunt angulation near the ventral outline. Left valve overlapping the right along the dorsal margin. Dorsal view spindle-shaped, widest just in front of the middle, ends compressed. Surface of the valves smooth, with scattered orifices of normal pore canals, except for a faint reticulate pattern near the anterior end and a few faint wrinkles parallel to the posteroventral margin. Eyespot slightly elevated.

Inner lamella broad in anterior end; zone of concrescence narrow, with few, wide-based, often bifurcating, radial and false radial pore canals; vestibule very wide. In the posteroventral margin, false radial canals extend into the keel, sometimes bifurcating. Adductor muscle scars form a short, compact, slightly curved row of four scars; frontal scar very small, irregularly-rounded. Hinge weak, in the left valve consisting of a long, curved, very slightly crenulate bar with terminal, elongate, slightly crenulate sockets.

Dimensions.—HVH No. 10602 (carapace), L: 0.43; H: 0.25; W: 0.20 (loc. NMB 17011).

Remarks.—*Phlyctocythere eocenica* Keij, 1958 (p. 72, pl. 1, figs. 11–12) has the same general outline, but the dorsal margin is more regularly curved and the posterior end is less attenuate. Keij mentions no differentiation of the hinge. *P. caudata* Hartmann, 1979 (p. 241, pl. 2, figs. 12–16, text-figs. 76–84) is almost identical in outline, but the posteroventral outline of the valve (above the keel) is straight instead of regularly curved, and on the other hand the keel is curved instead of truncate. That species also lacks the anterior reticulation. Nevertheless the resemblance between the Recent Australian form and the fossil Dominican one is very striking, especially as concerns internal features of hinge and marginal area.

Material.—Thirty-eight specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Santiago): (Table 4).

Phlyctocythere stricta, new species
Plate 12, figures 15, 16

Etymology of name.—(L.) *strictus* = straight [after the straight dorsal margin].

Diagnosis.—A species of *Phlyctocythere* with straight dorsal margin and subdorsally-located caudal process.

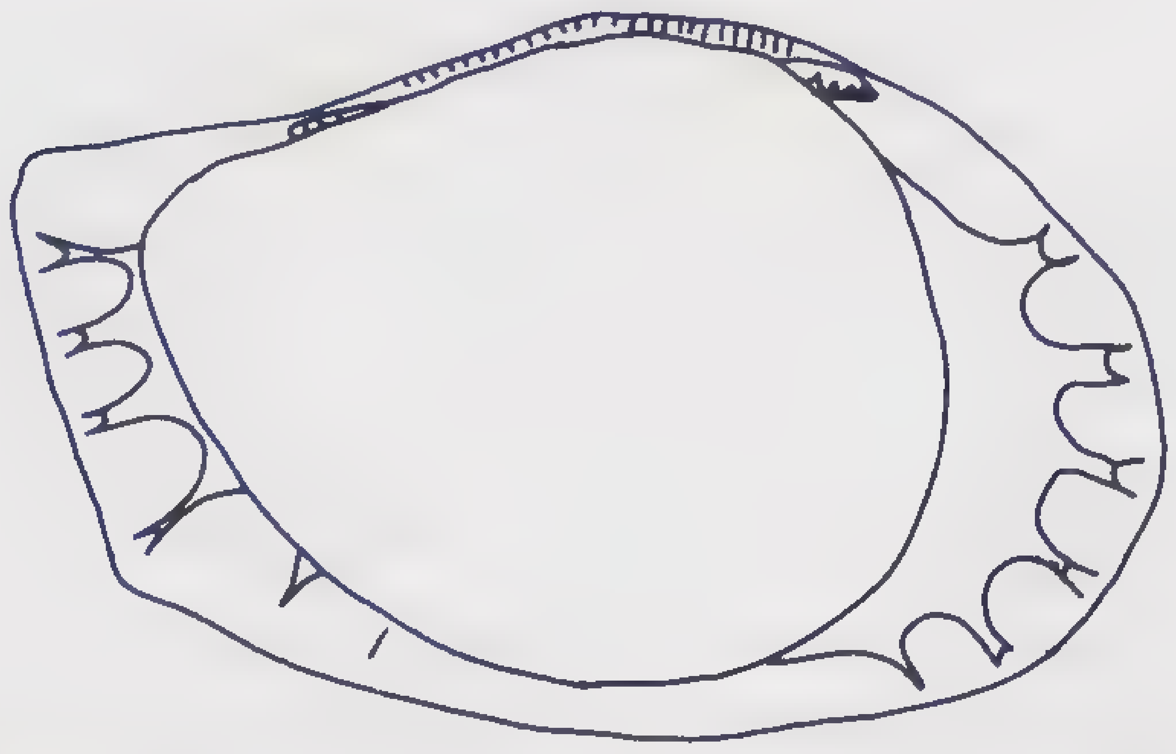
Holotype.—HVH No. 10594 (left valve).

Paratype.—HVH No. 10595 (right valve).

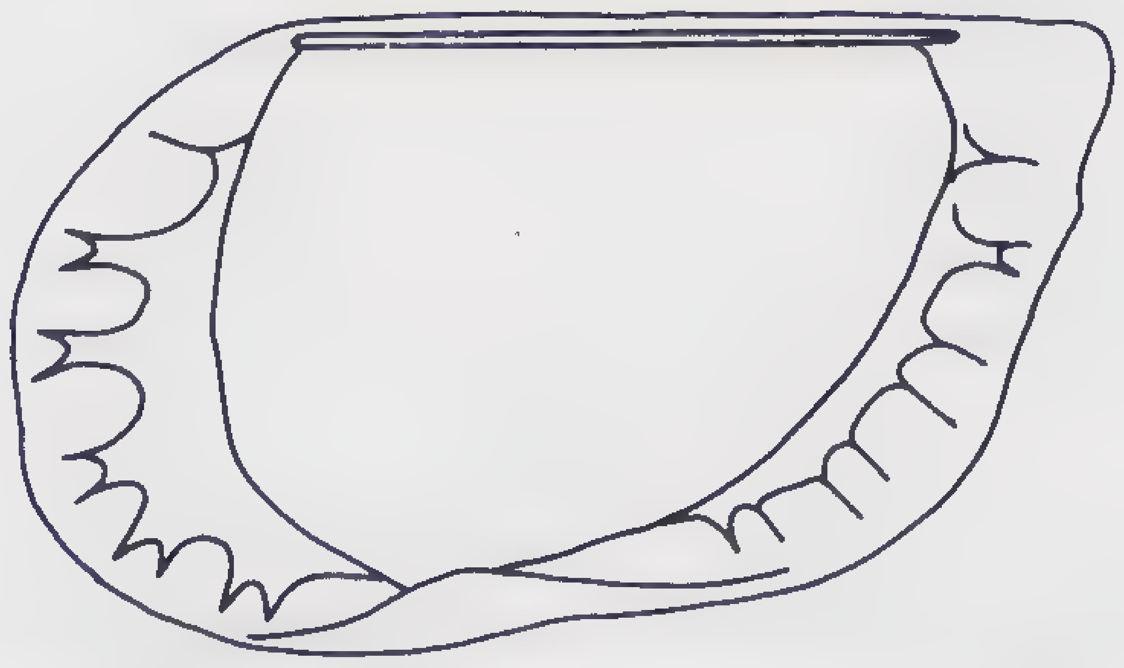
Type locality.—Loc. NMB 17183 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace short, subrectangular, greatest height at anterior cardinal angle, at two-sevenths



Text-figure 12.—*Phlyctocythere curva,* n. sp. HVH No. 10602, loc. NMB 17011, Gurabo Formation, Río Cana section. Interior of left valve, ×150.



Text-figure 13.—*Phlyctocythere recta,* n. sp. HVH No. 10602, loc. NMB 17010, Gurabo Formation, Río Cana section. Interior of right valve, ×150.

of the length from the anterior extremity. Shell very thin and fragile. Anterior margin almost regularly rounded in both valves; ventral margin slightly sinuate, posteroventral margin converging rapidly toward the subdorsally-located caudal process in a convex curve, bearing a thin, broadly rounded keel; posterior end rather blunt, margin almost straight below, concave above. Left valve barely overlapping the right, a little more strongly anterodorsally. Dorsal view spindle-shaped, widest about the middle, ends compressed. Surface smooth with scattered orifices of normal pore canals, except for a few wrinkles close and parallel to the posteroventral margin.

Hinge weak, only consisting of a bar in the right valve and a corresponding groove in the left. Marginal area broad anteriorly with wide vestibule. Pore canals few with wide bases, mostly not quite reaching the outer margin, and mostly paired. Posteroventral inner lamella wide with indented, paired, marginal pore canals.

Dimensions.—HVH No. 10595 (right valve), L: 0.46; H: 0.28 (loc. NMB 17183).

Material.—About 20 specimens.

Remarks.—Marginal area very similar to that of *P. curva,* but hinge more simple.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).

Phlyctocythere recta, new species
Plate 12, figures 17, 18; Text-figure 13

Etymology of name.—(L.) *rectus* = straight [because of the completely straight dorsal outline].

Diagnosis.—A species of *Phlyctocythere* with straight dorsal margin and continuous, slightly-upturned posterior end.

Holotype.—HVH No. 10596 (left valve).

Paratypes.—HVH No. 10597 (right valve), HVH No. 10598 (left valve).

Type locality.—Loc. NMB 17011 (Río Cana).

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace subrectangular, highest at one-third of the length from the anterior extremity. Anterior end regularly rounded, dorsal margin straight, slightly concave at posterior end in left valve; ventral margin almost straight, posteriorly converging towards the dorsal and swinging upward into an almost straight posterior margin; posterior end a dorsally-situated caudal process. Ventral and posterior margins possess a very thin keel, which forms posteroventrally a wider curve. Interior very similar to *P. stricta.*

Dimensions.—HVH No. 10596 (left valve, holotype), L: 0.43; H: 0.23; HVH No. 10597 (right valve), L: 0.43; H: 0.27 (loc. NMB 17011).

Material.—About 20 specimens.

Remarks.—This species is very similar to *P. stricta* and was first thought conspecific; however, the position of the posterior end is different. It might possibly be a dimorph of that species.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Phlyctocythere species 1
Text-figure 14

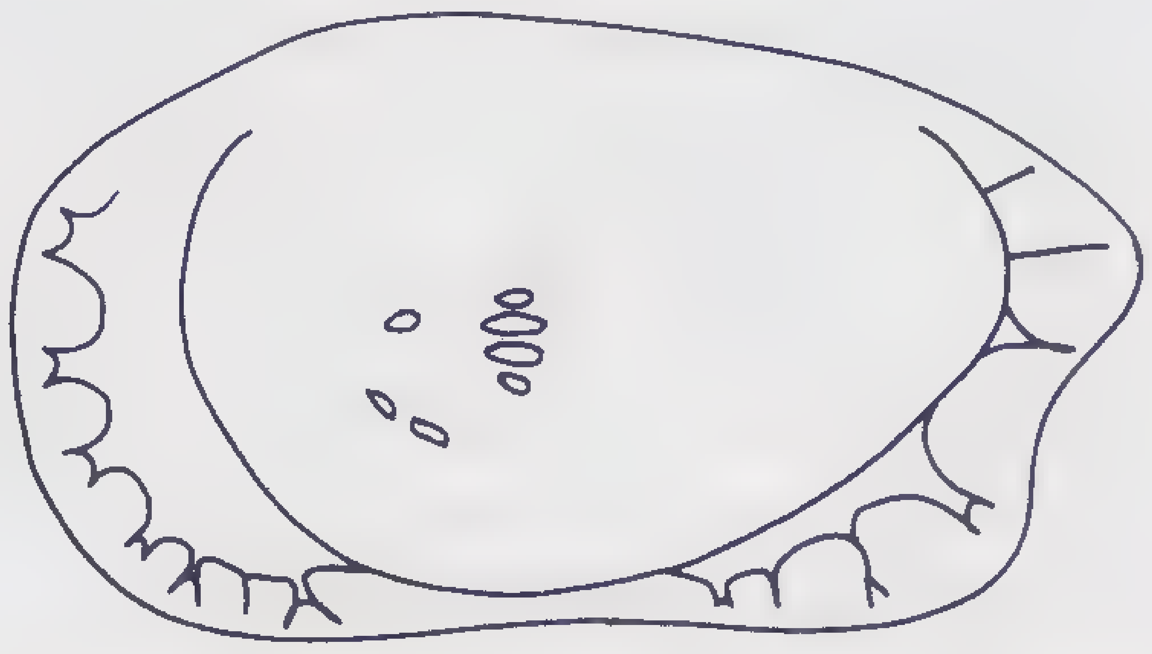
Description.—Carapace subovate, highest around the middle. Anterior margin evenly rounded; dorsal margin gently convex, ventral margin slightly sinuate, broadly curving upward into the posterior margin; posterior end located above the middle, posterodorsal margin concave. Marginal area broad with narrow anterior vestibule, where there are about 11 false radial pore canals, some of which bifurcate; in the posteroventral area the line of concrescence is more irregular with few, wide-based, false radial canals. Muscle scars form a posterior row of four elongate scars with a small frontal scar and two mandibular scars of which the posterior one is situated almost directly below the adductor group.

Dimensions.—HVH No. 10603 (right valve), L: 0.41; H: 0.23 (loc. NMB 16108).

Material.—Five specimens.

Remarks.—Similar in outline to *P. stricta,* but the posterior end is lower and the anterior marginal area has a narrower vestibule; line of concrescence ante-

Text-figure 14.—*Phlyctocythere* sp. 1. HVH No. 10603, loc. NMB 16108, Mao Formation, Río Gurabo section. Exterior of right valve, ×125.



Text-figure 15.—*Phlyctocythere* sp. 2. HVH No. 10608, station 1138 of Drooger and Kaasschieter (1958), Paria shelf, off Trinidad. Exterior of left valve, ×160.

riorly not indented at the base of the pore canals. *P. japonica* Ishizaki, 1981 (p. 62, pl. 11, fig. 13, pl. 12, fig. 10, pl. 13, figs. 11, 12, 13a, b, pl. 14, fig. 4 [= ?*P. hamanensis* Ikeya and Hanai, 1982, p. 52, pl. 4, figs. 1–4, pl. 6, figs. 12, 13, text-figs. 17a, b]) is similar in outline, but has a blunter posterior end and more evenly-rounded anterior end.

Occurrence.—Río Gurabo: Mao Formation (Table 2).

Phlyctocythere species 2
Text-figure 15

Description.—Carapace subovate to subrectangular. Anterior margin regularly rounded; dorsal margin straight, ventral margin slightly sinuate, parallel; posterior end just above median height, posterior margin straight above, somewhat irregular below. Marginal area as in *P. stricta.* Muscle scars form a vertical row of four small, elongate adductor scars with a single frontal scar and two mandibular scars.

Dimensions.—HVH No. 10605 (right valve), L: 0.46; H: 0.29 (loc. NMB 17011).

Material.—Twelve specimens.

Remarks.—The species differs from *P. stricta* by its lower posterior end. It might be the same species as the one described as *Pellucistoma tumida* Puri, 1954 (p. 290, pl. 15, fig. 5, text-fig. 12b; Hulings, 1967b, p. 651, fig. 6n) and as *Pseudocythere* aff. *fragilis* Sars by Kontrovitz (1976). Specimens in Rothwell's collection from the Gulf of Mexico (HVH No. 6357) collected at a depth between 40 and 430 m are identical to *Phlyctocythere* sp. 2, which has also been found at 65 m depth on the leeward side of the Alacran reef. Unfortunately this species cannot be identified with certainty as *P. tumida* (Puri), because the holotype of this species is a fragmented valve and repicking of the type sample failed to produce more specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Recent: Gulf of Mexico.

Family **CYTHERURIDAE** Müller, 1894

Subfamily **CYTHERURINAE** Müller, 1894

Genus **CYTHERURA** Sars, 1866

Cytherura cresera Bold
Plate 8, figure 1

Cytherura cresera Bold, 1968, p. 71, pl. 7, figs. 3a–d; Bold, 1971b, table 5.

Diagnosis.—An alate species of *Cytherura* with relatively coarse reticulation and a double dorsal ridge extending backwards from the eye tubercle.

Holotype.—HVH No. 8326.

Type locality.—Loc. H 15212, Maury's locality 1 on the Río Mao, Dominican Republic (Bold, 1968, text-fig. 4).

Stratigraphic horizon.—Gurabo Formation (Pliocene).

Dimensions.—HVH No. 8326 (left valve, holotype), L: 0.41; H: 0.22; W: 0.14; HVH No. 10609 (right valve), L: 0.36; H: 0.20 (loc. NMB 17011).

Material.—Fourteen specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Pliocene: Dominican Republic, Jamaica.

Cytherura species aff. **C. swaini** Bold
Plate 8, figure 2

Diagnosis.—A longitudinally-ribbed species of *Cytherura,* less elongate than *C. swaini* Bold, 1963b (p. 395, pl. 9, figs. 4a, b), and having the caudal process at median height instead of subventrally; fairly coarse anterior dentition.

Dimensions.—HVH No. 10610 (right valve), L: 0.33; H: 0.17 (loc. NMB 16090).

Material.—Six specimens.

Occurrence.—Río Gurabo: Mao Formation (Table 2).

Cytherura species A
Plate 8, figure 3

Diagnosis.—A species of *Cytherura* with long ventral ridge, no eye spot and longitudinal anterior ridges that become obscure in the center of the carapace.

Dimensions.—HVH No. 10611 (left valve), L: 0.34; H: 0.17 (loc. NMB 17011).

Material.—Four specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Cytherura species C
Plate 8, figures 4, 5

Diagnosis.—A species of *Cytherura* with a narrow-ribbed coarse reticulum enclosing numerous small pits, generally longitudinally-arranged.

Dimensions.—HVH No. 10613 (left valve), L: 0.31; H: 0.16 (loc. NMB 15983).

Material.—Five specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2). Río Yaque del Norte (López): (Table 4).

Cytherura species D
Plate 8, figure 6

Diagnosis.—A species of the *Cytherura johnsoni* group (Mincher, 1941, p. 343, pl. 47, figs. 1a–d) with

low longitudinal ridges in a fairly wide reticulum; anterior end blunt and high, posterior caudal process at median height.

Dimensions.—HVH No. 10614 (left valve), L: 0.40; H: 0.23 (loc. NMB 16156).

Material.—Two specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Cytherura species G
Plate 8, figures 7, 8

Diagnosis.—A species of *Cytherura* with relatively coarse reticulation in the posteroventral area, which projects over the ventral margin.

Dimensions.—HVH No. 10616 (right valve), L: 0.40; H: 0.22; HVH No. 10615 (left valve), L: 0.41; H: 0.23 (loc. NMB 16148).

Material.—Five specimens.

Remarks.—This species is close to *Serrocytherura panamensis* Ishizaki and Gunther, 1974 (p. 34, pl. 1, fig. 12, pl. 4, figs. 11–14, pl. 5, figs. 13, 14, text-figs. 19, 20), especially in the development of the posteroventral area, but differs by coarser reticulation and details of the ridge pattern. It is, however, possible that those differences are caused by intraspecific variation within a range of environments.

Occurrence.—Río Gurabo: Gurabo Formation: (Table 2); Río Yaque del Norte (Santiago): (Table 4).

Cytherura species H
Plate 8, figure 9

Diagnosis.—A species of *Cytherura* with subrectangular carapace, dorsal margin nearly straight and parallel to ventral, caudal process subdorsally; ornamentation with longitudinal ridges, the most prominent one of which forms a wide **V** with the lowest point just below the center of the carapace.

Dimensions.—HVH No. 10617 (left valve), L: 0.28; H: 0.15 (loc. NMB 17010).

Material.—Two specimens.

Occurrence.—Río Cana: Gurabo Formation: (Table 1).

Cytherura species I
Plate 8, figure 10

Diagnosis.—A species of the *Cytherura johnsoni* group (Mincher, 1941, p. 343, pl. 47, figs. 1a–d) with a fine, but wide-meshed reticulation and a dominant pattern of longitudinal ridges; dorsal margin less curved than in *C. johnsoni* Mincher, 1941, and greatest height situated more anteriorly.

Dimensions.—HVH No. 10618 (left valve), L: 0.27; H: 0.13 (loc. NMB 17003).

Material.—Two specimens.

Remarks.—Anterior end is less high and blunt than in *Cytherura* sp. D. It also shows some similarity to *Cytherura* sp. A, but lacks the prominent ventral ridge.

Occurrence.—Río Cana: Cercado Formation (Table 1).

Cytherura sp. B and *C.* sp. F occur as single specimens only and are not recorded in the distribution charts. *Cytherura* sp. B, from the Mao Formation of the Río Gurabo, is illustrated for the record (Pl. 8, fig. 11).

Genus **SEMICYTHERURA** Wagner, 1957

Semicytherura species aff. **S. arayaensis** Bold
Plate 8, figures 12, 13

Diagnosis.—A species of *Semicytherura* with vertical to oblique ridge pattern in the posteroventral portion of the carapace, and very fine punctation in the fossae of the reticulation.

Dimensions.—HVH No. 10619 (right valve), L: 0.38; H: 0.21 (loc. NMB 16054); HVH No. 10620 (left valve), L: 0.36; H: 0.22 (loc. NMB 16031).

Material.—Four specimens.

Remarks.—*S. arayaensis* Bold, 1966c (p. 31, pl. 4, figs. 3a, b) lacks the fine punctation within the fossae, and the loops formed by posteroventral ridges on both sides of a heavy vertical ridge are flatter.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Semicytherura species A
Plate 8, figures 14–16

Diagnosis.—A species of *Semicytherura* with prominent eye spot, placed rather far backwards at the end of a short anterodorsal ridge. Widest at one-third of the length from the posterior at a prominent vertical ridge from which several ridges strike forward, slightly diverging from the ventral margin and converging to a fairly prominent median ridge. Surface finely reticulate.

Dimensions.—HVH No. 10623 (right valve), L: 0.34; H: 0.19 (loc. NMB 16148); HVH No. 10621 (left valve), L: 0.35; H: 0.19 (loc. NMB 16973).

Material.—Sixteen specimens.

Remarks.—This species differs from *S. arayaensis* Bold, 1966c, and *S.* sp. aff. *S. arayaensis* by the flat, elongate-triangular area between the median ridge and the ventral ridges in the center of the valves, while the reticulation is much finer.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Genus **HEMICYTHERURA** Elofson, 1941

Hemicytherura bradyi (Puri)
Plate 8, figure 18

Kangarina, n. sp. 2. Puri and Hulings, 1957, p. 188, fig. 11.
Kangarina bradyi Puri, 1960, p. 119, pl. 4, figs. 6, 7; Baker and Hulings, 1966, p. 144.
Hemicytherura cranekeyensis Puri. Bold, 1968, p. 72 (part), pl. 7, fig. 7b [not fig. 7a]; Bold, 1975c, tables 2, 4 (part); Bold, 1978b, table 9 (part).
Hemicytherura bradyi (Puri). Maddocks, 1974, p. 210, pl. 4, figs. 14–17; Teeter, 1975, p. 470, figs. 16i, 17m; Bold, 1975a, table 5.

Diagnosis.—A species of *Hemicytherura* with very coarse reticulum, showing three wide fossae above a median ridge and four to six ventral fossae below it; vertically-elongate reticulum in posterior part.

Holotype.—HVH No. 4739.

Type locality.—Shore sand, Bahia Honda, Florida.

Stratigraphic horizon.—Recent.

Dimensions.—HVH No. 10624 (right valve), L: 0.29; H: 0.19 (loc. NMB 16978).

Material.—More than 100 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo Formation (Table 2).

Distribution.—Upper Miocene to Recent: Caribbean, Gulf of Mexico.

Hemicytherura cranekeyensis Puri
Plate 8, figure 17

Cytherura clathrata Sars. Bold, 1946, p. 118, pl. 14, figs. 9a, b, 10a, b [not *C. clathrata* Sars, 1866, p. 77].
Hemicytherura videns (Müller). Bold, 1957b, p. 245 (part) [not pl. 4, fig. 12]; Bold, 1966b, p. 7 [not *Cytheropteron videns* Müller, 1894, p. 383, pl. 29, figs. 2, 8].
Kangarina sp. 1. Puri and Hulings, 1957, pp. 183, 188, fig. 11.
Hemicytherura cranekeyensis Puri, 1960, p. 115, pl. 4, figs. 4, 5; Benda and Puri, 1962, p. 336, pl. 4, fig. 12; Hulings and Puri, 1964, p. 320, figs. 11, 17; Bold, 1966c, table 2; Morales, 1966, p. 53, pl. 4, figs. 8a, b; Bold, 1968, p. 72 (part), pl. 7, fig. 7a [not fig. 7b]; Bold, 1970a, table 1; Teeter, 1973, table 1; Teeter, 1975, p. 469, figs. 16b, 17l; Bold, 1975a, tables 12, 15; Bold, 1975c, tables 2, 4, 5 (part); Bold, 1978b, table 9 (part).
Hemicytherura aff. *cranekeyensis* Puri. Bold, 1967b, table 1.
Hemicytherura sp. Bold, 1963b, p. 398, pl. 9, fig. 5.
?*Hemicytherura cranekeyensis* Puri. McKenzie and Swain, 1967, p. 201, pl. 28, figs. 27a, b, text-fig. 12; Lubimova and Sánchez-Arango, 1974, p. 112 (part?), pl. 18, figs. 3, 3a.
Not *Hemicytherura cranekeyensis* Puri. Swain, 1969, p. 463.

Diagnosis.—A species of *Hemicytherura* with a reticulum consisting of two central, three anterior, two or three ventral meshes, and one posterior mesh.

Holotype.—HVH No. 4738.

Type locality.—Shore sand, Bahia Honda, Florida.

Stratigraphic horizon.—Recent.

Dimensions.—HVH 10625 (carapace), L: 0.29; H: 0.18; W: 0.13 (loc. NMB 16978).

Material.—About 40 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Middle Miocene to Recent: Caribbean; Recent: Gulf of Mexico, possibly also present on Pacific coast of North America.

Hemicytherura species
Plate 8, figure 19

The two identified species of *Hemicytherura* are nearly always accompanied by immature molts, probably belonging mostly to *H. bradyi*. However, some of them reach a size that is only slightly less than that of the adults of either species. These have been separated on the distribution charts and are figured as a matter of record.

Dimensions.—HVH No. 10627 (carapace), L: 0.26; H: 0.17; W: 0.12 (loc. NMB 16978).

Material.—About 30 specimens.

Occurrence.—Río Cana: Cercado, Gurabo, and Mao formations (Table 1). Río Gurabo: Gurabo Formation (Table 2).

Genus **EUCYTHERURA** Müller, 1894

Eucytherura ex gr. **complexa** (Brady)
Plate 9, figures 1–4

?*Cythere complexa* Brady, 1867, p. 210; Brady and Norman, 1889, p. 145, pl. 19, figs. 31, 32.
?*Eucytherura complexa* (Brady). Müller, 1894, p. 306, pl. 20, figs. 13, 17*.
Eucytherura aff. *complexa* (Brady). Keij, 1954, p. 228, pl. 5, figs. 13, 14; Bold, 1972a, table 4.
Eucytherura sp. 1. Drooger and Kaasschieter, 1958, p. 89.
Eucytherura complexa (Brady). Bold, 1963b, p. 389, pl. 9, figs. 2a, b; Bold, 1966c, p. 14, table 2; Bold, 1967b, table 1; Bold, 1972a, table 2.
Eucytherura ex gr. *complexa* (Brady). Bold, 1978b, table 9.
Not *Eucytherura complexa* (Brady). Bold, 1957b, p. 245, pl. 4, fig. 14.
Not *Eucytherura complexa* (Brady). Ishizaki and Gunther, 1974, p. 44, pl. 1, figs. 1–3, pl. 2, figs. 1, 2, text-fig. 26.

Diagnosis.—A subquadrate species of *Eucytherura* with a strong, vertical, posterior ridge, prominent ventral ridge and subcentral tubercle.

Reference material.—HVH No. 10627.

Reference locality.—Orinoco–Paria shelf, Venezuela.

Stratigraphic horizon.—Recent. The material considered under this name was collected by the Paria–Trinidad–Orinoco shelf expedition (see Drooger and Kaasschieter, 1958; Fithian, 1980).

Dimensions.—Recent material: HVH No. 10627 (left valve), L: 0.31; H: 0.18 (Station 1021 of Drooger and

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* Designated as *Eucytherura dilatata* Müller, 1894 in explanation of plate.

Kaasschieter, Orinoco–Paria shelf); HVH No. 10628 (right valve), L: 0.30; H: 0.17 (same locality). Fossil material: HVH No. 10629 (left valve), L: 0.26; H: 0.17 (loc. NMB 16964); HVH No. 10630 (right valve), L: 0.26; H: 0.17 (loc. NMB 16132).

Material.—Twenty-four specimens.

Remarks.—The posterior ridge is similar to that in the European forms (Brady and Norman, 1889; Müller, 1894) and is lacking in Ishizaki and Gunther's figures. However, there are some differences, which appear to be too consistent to be explained by intraspecific variation, *e.g.,* the coarser anterior dentition of the Caribbean species and the irregularly-nodose development of the posterior part of the ventral ridge. Within the Caribbean material there is also some variation which is probably phenotypic, *e.g.,* the size of the eye tubercle (larger than those of the European form, and probably dependent on the depth at which the species lived), and the size of the ridge connecting the subcentral and eye tubercle. The Recent specimens from the Venezuelan shelf are somewhat larger than the fossil specimens from Trinidad and the Dominican Republic.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Recent: Dominican Republic, Trinidad, Venezuela, Colombia, Panama, Costa Rica; Recent: Gulf of Mexico. Rothwell (1949) found almost identical specimens (HVH No. 6347) over a depth range of 40–250 m, with a few deeper records, but concentrated around 90 m.

Eucytherura fithianae, new species
Plate 9, figure 5

Etymology of name.—After Patricia A. Fithian (Shell Oil Co., Houston, TX), who discovered this species on the Paria shelf.

Diagnosis.—A species of *Eucytherura* with a triangular ridge pattern with the apex near the ventral margin, somewhat behind the middle, and one corner near the posterior cardinal angle.

Holotype.—HVH No. 10631 (right valve).

Paratype.—HVH No. 10632 (right valve).

Type locality.—Loc. NMB 17183 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation (Pliocene).

Description.—Carapace rectangular with pronounced anterior cardinal angle. Anterior margin almost evenly rounded, except for a small concavity just below the anterior cardinal angle; dorsal and ventral margins almost straight and parallel; posterior end a subdorsal caudal process. Greatest width at two-fifths of the length from the posterior extremity. From this point near the ventral margin, a conspicuous ridge runs up to a very short dorsal ridge at the posterior cardinal angle, while perpendicular to this ridge a subventral ridge runs towards the middle of the anterior end. This ridge is paralleled by a lower and an upper one, the latter starting at the subcentral tubercle. From the subcentral area a ridge runs obliquely backward and upward and joins the dorsal ridge almost at the point where the posterior ridge joins it, thus closing in a triangle. However, the last-mentioned ridge spoils the triangular effect by making a sharp zig-zag just about its mid-length. From the subcentral tubercle a short ridge connects with a prominent eye node, just behind the anterior cardinal angle. From the posterior cardinal angle (dorsal ridge), a smaller ridge runs vertically down and separates the very strongly-compressed posterior end from the rest of the carapace. Between these ridges the surface is covered with a fine network.

Dimensions.—HVH No. 10631 (right valve, holotype), L: 0.29; H: 0.16; HVH No. 10632 (right valve), L: 0.31; H: 0.17 (loc. NMB 17183).

Material.—Eight specimens.

Remarks.—This species bears a very strong resemblance to *Eucytherura*? sp. of Bonaduce *et al.,* 1980 (p. 164, pl. 6, fig. 12) from the Gulf of Aqaba; however, on close inspection there are a number of small differences, especially the non-spinose anterior margin of the Caribbean species.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Distribution.—Recent: Paria–Orinoco shelf at 73 and 77 m depth (rare).

Eucytherura species A
Plate 9, figures 6, 7

Diagnosis.—A species of *Eucytherura,* resembling *E. complexa* (Brady, 1867), but with irregular posterior ridge, more strongly-projecting ventral ridge and less projecting subcentral tubercle.

Dimensions.—HVH No. 10633 (left valve), L: 0.27; H: 0.16; HVH No. 10634 (right valve), L: 0.26; H: 0.16 (loc. NMB 17008).

Material.—Six specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2).

Eucytherura species B
Plate 9, figure 8

Diagnosis.—A short, rectangular, alate species of *Eucytherura.*

Dimensions.—HVH No. 10635 (left valve), L: 0.23; H: 0.14; W: 0.14 (loc. NMB 15983).

Material.—Two specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Eucytherura species C
Plate 9, figures 9, 10

Diagnosis.—A species of *Eucytherura,* with prominent dorsal and ventral ridges and a coarsely dentate anterior end (four large spines).

Dimensions.—HVH No. 10637 (left valve), L: 0.25; H: 0.16; HVH 10636 (right valve), L: 0.26; H: 0.15 (loc. NMB 16148).

Material.—Six specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Distribution.—The same species has been found in the Gulf of Mexico (Rothwell, 1949, HVH No. 6354) at varying water depths (80–300 m).

Eucytherura species D
Plate 9, figure 11

Diagnosis.—An elongate, alate species of *Eucytherura* with spinose dorsal ridge and very coarsely dentate anterior end (four to five spines).

Dimensions.—HVH No. 10638 (left valve), L: 0.34; H: 0.13 (loc. NMB 16125).

Remarks.—In general shape, *Eucytherura gibbera* Müller, 1894 (p. 307, pl. 20, figs. 14, 19, see also Bonaduce and Pugliese, 1977, pl. 4, fig. 2, and Colalongo and Pasini, 1980, p. 48, pl. 21, fig. 6) is similar, but differs in the degree of anterior dentition and details of the ornamentation. *Typhloeucytherura* sp. of Cronin, 1983 (pl. 6, fig. D) is also quite similar but shorter.

Material.—Two specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Eucytherura species E
Plate 9, figures 12, 13

Diagnosis.—An elongate, alate species of *Eucytherura* with coarse anterior dentition; anterior end very blunt, large eye node.

Dimensions.—HVH No. 10639 (left valve), L: 0.27; H: 0.13 (loc. NMB 16978).

Material.—Thirteen specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Mao Formation (Table 2).

Eucytherura species G
Plate 9, figure 14

Diagnosis.—A broadly alate species of *Eucytherura* with irregularly angular, fairly coarse reticulation, which trends into the posterior side of the ala.

Dimensions.—HVH No. 10640 (left valve), L: 0.31; H: 0.18 (loc. NMB 16108).

Material.—Two specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Eucytherura species

Dimensions.—Right valve, L: 0.32; H: 0.20 (Laguana amber site, No. 27).

Material.—One specimen.

Occurrence.—Laguana amber site: (Table 5).

Genus **KANGARINA** Coryell and Fields, 1937

Kangarina depressa Bold
Plate 9, figure 15

Kangarina depressa Bold, 1968, p. 74, pl. 7, figs. 5a, b, pl. 8, fig. 7; Bold, 1971b, tables 4, 5; Bold, 1975a, table 15; Bold, 1978b, table 9.

Diagnosis.—A slightly alate species of *Kangarina* of elongate shape and with a hook-shaped posteroventral spine. Conspicuous ridges connect the subcentral area with the anterior cardinal angle and the lower half of the anterior margin.

Holotype.—HVH No. 8335.

Type locality.—Loc. H 15212, Río Mao at Paso Bajito (= Maury's loc. 1, loc. USGS 8527), Dominican Republic (Bold, 1968, text-fig. 4).

Stratigraphic horizon.—Gurabo Formation.

Dimensions.—HVH No. 10642 (right valve), L: 0.36; H: 0.18 (loc. NMB 16132).

Material.—More than 80 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Middle Miocene to Recent: Dominican Republic, Jamaica, Costa Rica, Mexico.

Kangarina quellita Coryell and Fields
Plate 9, figure 16

Kangarina quellita Coryell and Fields, 1937, p. 13, pl. 2, figs. 15a–c; Puri, 1954, p. 248, pl. 4, fig. 9; Bold, 1958, p. 416, pl. 4, fig. 8; Bold, 1963b, p. 396, pl. 10, fig. 2; Bold, 1966b, p. 7; Bold, 1966e, table 1; Bold, 1967b, p. 312, pl. 1, fig. 14; Bold, 1968, table 9; Bold, 1970b, p. 40; Bold, 1971b, table 5; Bold, 1972a, table 2; Bold, 1975a, table 15; Bold, 1978b, tables 8, 9.

Diagnosis.—A short, subquadrate species of *Kangarina* with wide posterior loop in the ridge pattern.

Holotype.—AMNH 24899.

Type locality.—Cativa, Panama.

Stratigraphic horizon.—Gatun Formation (upper Miocene).

Dimensions.—HVH No. 10641 (right valve), L: 0.42; H: 0.18 (loc. NMB 16132).

Material.—Twenty-six specimens.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3).

Distribution.—Middle Miocene to Pliocene: Greater Antilles, Central America, Colombia, Venezuela.

Kangarina species

Remarks.—Unidentifiable molts, probably mostly *K. depressa* Bold, 1968.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2).

"**Kangarina**" species aff. "**K**". **abyssicola** (Müller)
Plate 9, figure 17

Kangarina abyssicola (Müller). Bold, 1963b, p. 397, pl. 10, fig. 1; Bold, 1966a, p. 14, table 2; Bold, 1971b, table 5.
Kangarina? *abyssicola* (Müller). Bold, 1972a, table 2.
Kangarina sp. aff. *K. abyssicola* (Müller). Bold, 1975a, tables 2, 5.
?*Kangarina* sp. Maddocks, 1974, p. 210, pl. 4, figs. 3, 7, 8, 10, 11.

Diagnosis.—A species related to *Cytheropteron abyssicolum* Müller, 1894 (p. 302, pl. 20, figs. 5, 11) with punctate surface and a long ridge on the dorsal margin of the left valve.

Dimensions.—HVH No. 10643 (left valve), L: 0.32; H: 0.18; HVH 10643 (right valve), L: 0.29; H: 0.17 (loc. NMB 17183).

Material.—Three specimens.

Remarks.—This species differs from *Cytheropteron abyssicolum* (Müller) by the discontinuity of the oblique median ridge in the center of the valves. This group of species to which also belongs *Hemicytherura radiata* Hornibrook, 1952 (p. 61, pl. 14, figs. 217, 218, 227, 228) differs from typical *Kangarina* in shape (curved dorsal margin) and ridge pattern, and should probably be assigned to a new genus.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Distribution.—Pliocene: Dominican Republic, Jamaica, Cuba, Trinidad. A Recent representative of this group on the shelf North of Trinidad may be identical to Müller's species.

Genus **SAIDA** Hornibrook, 1952

Saida? **kingmai** (Bold)
Plate 9, figure 18

Cytherura kingmai Bold, 1946, p. 117, pl. 14, fig. 14.

Holotype.—GIRU S 13066.

Type locality.—Loc. T 1439, 2 km southwest of Banes on road to Santa Isabel de Nipe, Oriente Province, Cuba.

Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (= Júcaro Formation of Kozary, 1957, Jakus, 1983, p. 62).

Description.—Carapace subrectangular; dorsal and ventral margin slightly concave and parallel; anterior end almost evenly rounded, rimmed and bearing six fairly large, blunt spines; posterior end is a very short, subdorsal, caudal process, very strongly laterally compressed behind a vertical posterior ridge that extends ventrally as a backwardly-pointing spine. From the dorsal end of this ridge another prominent ridge curves downward, reaching its lowest point about midway between the center of the carapace and the ventral margin. The carapace is laterally compressed below this ridge. All ridges are wide and smooth and the surface between them is finely punctate.

Hinge in the right valve has a long, rather wide, crenulate groove slightly broader just in front of the small terminal teeth, the posterior one of which has three crenulations. The marginal area is broad anteriorly, line of concrescence and inner margin seem to coincide; marginal pore canals rather widely spaced, partly standing in groups. Muscle scar not observed.

Dimensions.—HVH No. 10644 (right valve), L: 0.28; H: 0.16 (loc. NMB 17183).

Material.—One specimen.

Remarks.—Originally assigned to *Cytherura,* this species shows a surface ornamentation that is reminiscent of *Saida.* However the latter genus does not possess a caudal process, so that the generic assignment remains questionable.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Distribution.—Upper Miocene: Cuba, Dominican Republic.

Subfamily **CYTHEROPTERINAE** Hanai, 1957

Genus **CYTHEROPTERON** Sars, 1866

Subgenus **CYTHEROPTERON** Sars, 1866

Cytheropteron (Cytheropteron) dominicanum, new species
Plate 10, figures 4–10

Cytheropteron sp. aff. *C. leonensis* Puri. Bold, 1966c, p. 34, pl. 3, figs. 1a–c, table 1; Bold, 1967b, table 1; Bold, 1968, table 5; Bold, 1970b, table 1; Bold, 1972a, table 2; Bold, 1978b, tables 2, 8, 9.
Cytheropteron sp. Bold, 1975c, table 4.

Etymology of name.—After its occurrence in the Dominican Republic.

Diagnosis.—A small species of *Cytheropteron* with broad, convex ventral ridge.

Holotype.—HVH No. 10649 (left valve, female).

Paratypes.—HVH No. 10650 (left valve, female), HVH No. 10651 (left valve, right valve, female), HVH No. 10652 (left valve, female), HVH No. 10653 (left valve, right valve, female), HVH No. 10654 (four right valves, female, four left valves, female, one right valve, male, one left valve, male).

Type locality.—Loc. NMB 16964 (Río Cana).

Stratigraphic horizon.—Gurabo Formation.

Description.—Female: Carapace small, in side view subtriangular, highest in the middle. Anterior margin obliquely rounded, dorsal margin arched with in the right valve a small concavity at the junction with the

anterior margin; ventral margin gently convex; posterior end rounded subventrally, concave above. Dorsal view broadly spindle-shaped, widest just behind the middle; posterior end more strongly laterally-compressed than anterior end; posterolateral sides slightly concave. A broad ala overhangs the middle two-thirds of the ventral margin, and possesses a wide rim with a depressed area just above it and parallel to it. Surface weakly reticulate with shallow fossae and broad, low ridges, the pattern of which is vertical in the dorsal portion, parallel to the ventral outline in the ventral part; the fossae diminish in size towards the ends.

Marginal area broad in anterior end with shallow but wide vestibule; a small number of radial and false radial pore canals. Hinge consists in the left valve of a convex, crenulate ridge with short, terminal, crenulate sockets. In the right valve short terminal, crenulate teeth and a curved median groove. Muscle scars form a vertical row of four with a single V-shaped scar in front.

Male?: Carapace in side view subovate in the right valve, to subtriangular in the left; greatest height in front of the middle. Anterior end obliquely rounded; dorsal margin arched in left valve, convex in right; ventral margin convex in left valve, straight in right with slight anterior concavity. In the left valve the ala is similar to that of the female, in the right valve, however, the rim of the ala is almost straight and obscures the ventral margin only behind the middle. Reticulations similar to female, in dorsal view widest behind the middle. The males? are much lower than the females and would not have been considered to belong to the same species except for the fact that they are nearly always found together, with the females much more numerous than the males(?).

Dimensions.—HVH No. 10651 (right valve, female), L: 0.27; H: 0.20; W: 0.08 (loc. NMB 16964); HVH No. 10649 (left valve, female, holotype), L: 0.26; H: 0.18; W: 0.06; HVH No. 10654 (right valve, ?male), L: 0.25; H: 0.16; HVH No. 10654 (left valve, ?male), L: 0.26; H: 0.17 (loc. NMB 16156).

Material.—More than 100 specimens.

Remarks.—The species is related to *C. subreticulatum* Bold, 1946 (p. 113, pl. 14, figs. 6a, b) and *C. yorktownensis* (Malkin, 1953) [= *C. leonensis* Puri, 1954; see Forester, 1980, p. 9, pl. 2, fig. 7], but is much smaller and has a stronger ventral ridge. *C. ventrokurtosa* Swain, 1967 (p. 65, pl. 4, figs. 9a, b, pl. 9, figs. 11a–d, text-fig. 45) is somewhat larger and has three or four ridges more or less parallel to the ventral outline of the ala.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Recent: Jamaica, Dominican Republic, Costa Rica. The same species has been found in the Gulf of Mexico (Rothwell, 1949) in material of the *Atlantis* cruise 1947 [HVH No. 6325, "*Cytheropteron inflatum*"] at 73 m depth.

Cytheropteron (Cytheropteron) guraboense, new species
Plate 10, figures 1–3

Cytheropteron sp. Bold, 1968, p. 73, pl. 7, figs. 2a–c, pl. 8, fig. 1; Bold, 1971b, pl. 3, fig. 10, table 4.

Etymology of name.—After its occurrence in the Río Gurabo section.

Diagnosis.—A small species of *Cytheropteron* with a narrow, pointed ala, which has a large spine on its posterior side and a small notch just anterior to the point of the ala.

Holotype.—HVH No. 10645 (left valve).

Paratypes.—HVH No. 10646 (right valve), HVH No. 10647 (three right valves, one left valve), HVH No. 10648 (right valve).

Type locality.—Loc. NMB 15978 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace ovate in side view, pointed behind at median height, greatest width in the middle, strongly alate. Anterior margin obliquely rounded, dorsal margin arched in the left valve, straight in the right; ventral margin convex, slightly sinuate in the middle, curving upward to the posterior end; posterior margin almost straight below, concave above the caudal process. Ala narrow, curved backward with a pointed end in front of which is a small notch indicating the end of a slightly thickened rim, and with a strong, flat spine on the posterior rim. There is a shallow sulcus in the frontal part of the ala, not quite reaching median height. Dorsal view arrow-shaped, sides of the alae convex, greatest width at about one-third of the length from the posterior extremity.

Marginal area rather broad in anterior end, with a shallow vestibule and few (about six) false radial pore canals. Hinge consists in the left valve of a median, curved bar with terminal, small, rounded sockets. Muscle scars form a posterior row of four with a single V-shaped scar in front.

Dimensions.—HVH No. 10645 (left valve, holotype), L: 0.33; H: 0.18; W: 0.20 (loc. NMB 15978); HVH No. 10648 (right valve), L: 0.33; H: 0.16; W: 0.18 (loc. NMB 16973).

Material.—More than 50 specimens.

Remarks.—Very similar, possibly identical, to specimens found in *Atlantis* cruise 1947 material from the Gulf of Mexico (HVH No. 6335), mostly from shallow water (60–80 m) with some from 120–260 m, and a few from deep water (rare). Material deposited by Rothwell (1949).

Occurrence.—Río Cana: Cercado and Gurabo for-

mations (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Pleistocene: Jamaica, Dominican Republic, Costa Rica; Recent: Gulf of Mexico(?).

Subgenus **AVERSOVALVA** Hornibrook, 1952

Cytheropteron (Aversovalva) bijuduvali, new species
Plate 10, figures 15–18

Cytheropteron sp. aff. *C. hamatum* Sars. Bold, 1971b, p. 338, pl. 12, figs. 11a, b (not Bold, 1966c, p. 33, pl. 3, figs. 2a, b).
Cytheropteron sp. Bold, 1981, p. 85, pl. 3, fig. 12, table 14.

Etymology of name.—In honor of Bernard Biju-Duval, Institut français du Pétrole, sedimentologist of the Dominican Republic project.

Diagnosis.—A species of *Cytheropteron* with the right valve overlapping the left along the dorsal margin and the left overlapping the right ventrally; a broad ala with a sharp anterior rim obscures part of the ventral margin.

Holotype.—HVH No. 10659 (right valve).

Paratypes.—HVH No. 10660 (right and left valves), HVH No. 10661 (left valve), HVH No. 10662 (right valve), HVH No. 10663 (carapace).

Type locality.—Loc. NMB 15982 (Río Gurabo).

Stratigraphic horizon.—Upper Gurabo Formation (Pliocene).

Description.—Carapace ovate in side view, highest at five-ninths of the length from the anterior extremity in the right valve. Anterior margin almost regularly rounded, continuing into the dorsal margin of the left valve without interruption; in the right valve the dorsal outline is formed by a high, arched ridge with a small concavity at its junction with the anterior margin and continuing with a much stronger concavity into the posterior end; ventral margin almost straight in the right valve, convex in the left, bending upward in a wide curve towards the caudal process, which is located above median height and slightly deflected upward. A broad wing obscures the middle part of the ventral margin; its anterior side is flattened and sharp, the posterior side exhibits one or more flat spinal extensions. Surface in most specimens smooth. In some a regularly-distributed punctation occurs. Dorsal view arrow-shaped, width about equal to length; anterior and posterior ends compressed with concave sides. Greatest width at the tip of the ala, at two-thirds of the length from the anterior end. Lateral outline of the alae somewhat sinuous with a terminal small spine and flat posterior carina, generally broken up into one or more flat, bladelike spines.

Hinge in the right valve with a deep groove into which fits the crenulate median bar of the left valve; terminal elements very small, short and crenulate. Marginal area broad in anterior end with a small vestibule and few straight, simple, marginal pore canals.

Dimensions.—HVH No. 10659 (right valve, holotype), L: 0.45; H: 0.25; HVH No. 10661 (left valve), L: 0.45; H: 0.23 (loc. NMB 15982).

Remarks.—The species appears related to *C. horacecoryelli* Puri of Howe and Bold, 1975 (pl. 3, fig. 1: not Puri, 1960), but possesses a narrower and less curved dorsal margin.

Material.—More than 50 specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Pliocene: Hispaniola, Jamaica. Recent: Gulf of Mexico (Rothwell, 1949, *Atlantis* cruise 1947, type no. 30, HVH No. 6348 under the name of "*Cytheropteron alatum* Sars"). Rothwell included under this name also *Cytheropteron* (*Lobosocytheropteron*) *palton* Bold, so that the distribution that he gives is somewhat suspect. The main distribution in the Gulf of Mexico appears to be between depths of 100 and 325 m.

Subgenus **LOBOSOCYTHEROPTERON** Ishizaki and Gunther, 1974

Cytheropteron (Lobosocytheropteron) palton Bold
Plate 10, figures 11–14

Cytheropteron n. sp. A. Bold, 1964, p. 8, table 2.
Cytheropteron palton Bold, 1966c, p. 33, pl. 1, figs. 7a, b, table 2; Bold, 1971b, table 3; Bold, 1972a, table 2; Breman, 1982, pl. 3, fig. F.
Cytheropteron nipeensis Bold. Bold, 1967b, p. 312, pl. 1, fig. 11 [not *C. nipeensis* Bold, 1946, p. 113, pl. 16, figs. 1a, b].

Diagnosis.—A species of *Lobosocytheropteron* with irregularly-convex dorsal margin and sharply pointed alae.

Holotype.—USNM 649188.

Type locality.—Loc. Bermúdez 8, Margarita, Venezuela.

Stratigraphic horizon.—Cubagua Formation (Pliocene).

Dimensions.—HVH No. 10656 (left valve), L: 0.50; H: 0.25; HVH No. 10657 (left valve, large specimen), L: 0.55; H: 0.29 (loc. NMB 15982).

Remarks.—*Lobosocytheropteron perlaensis* Ishizaki and Gunther, 1974 (p. 40, pl. 7, fig. 6) has the same shape, but slightly smaller dimensions and differs in small details. It might, however prove to be identical. That species was found at depth of less than 50 m in the Gulf of Panama.

Material.—More than 70 specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene to Recent: Dominican Republic, Trinidad, Venezuela, Colombia, Panama, Costa Rica, Jamaica; Recent: Gulf of Mexico.

Subfamily **PARACYTHERIDEINAE** Puri, 1957

Genus **PARACYTHERIDEA** Müller, 1894

Paracytheridea altila Edwards
Plate 11, figure 1

Paracytheridea altila Edwards, 1944, p. 512, pl. 85, figs. 20–21; Bold, 1968, p. 76 (with synonymy), pl. 7, figs. 1a–d. Valentine, 1971, pl. 3, figs. 31–34; Bold, 1972a, table 2; Bold, 1973b, table 1; Bold, 1975c, table 2; Swain, 1974, p. 20, pl. 1, fig. 17; Cronin, 1979, p. 146, pl. 4, figs. 1–4; Forester, 1980, p. 20, pl. 7, fig. 7; Hazel, 1983, pl. 28, fig. 4.

Diagnosis.—A species of *Paracytheridea* with a large, rounded, posterodorsal boss.

Holotype.—USNM 559415.

Type locality.—Natural Well, Magnolia, North Carolina.

Stratigraphic horizon.—Upper Duplin marl (Pliocene).

Dimensions.—HVH No. 10665 (right valve), L: 0.63; H: 0.27 (loc. NMB 16103).

Material.—Five specimens.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Lower Miocene to Pliocene: Caribbean, Gulf Coast, Atlantic coast U. S.; Recent: U. S. Atlantic coast.

Paracytheridea calcitrapa, new species
Plate 11, figures 4–11

Paracytheridea sp. aff. *P. hispida* Bold. Bold, 1968, p. 76, pl. 4, figs. 6a, b; Bold, 1971b, table 4; Bold, 1975c, table 2.
Not *Paracytheridea* aff. *hispida* Bold. Lubimova and Sánchez-Arango, 1974, pl. 19, figs. 6, 6a; Bold, 1973b, table 1; Neufville, 1979, p. 157, pl. 7, figs. 7a, b.

Etymology of name.—(Neolatin) *calcitrapa* = a four-pointed weapon.

Diagnosis.—A small species of *Paracytheridea* with high, pointed, anterior cardinal angle, high posterodorsal projection, long caudal process and long, pointed alae.

Holotype.—HVH No. 10668 (left valve).

Paratypes.—HVH No. 10669 (left valve), HVH No. 10670 (right valve), HVH No. 10671 (right valve), HVH No. 10672 (left valve), HVH No. 10673 (right valve), HVH No. 10674 (left valve), HVH No. 10675 (right valve).

Type locality.—Loc. NMB 16185 (Río Gurabo).

Stratigraphic horizon.—Cercado Formation.

Description.—Carapace small, elongate, cuneiform in side view with four strong, pointed projections, highest at the strongly-elevated anterior cardinal angle in the left valve. Anterior margin very obliquely rounded in the left valve, almost evenly rounded in the right; dorsal margin straight, ventral margin slightly sinuous, converging posteriorly towards the dorsal margin; posterior end an upwardly deflected, subdorsal caudal process. Ala long, thin, backwardly curved with a strong anterior rim. Subcentral node placed rather far forward, consisting of a high ridge that extends forward toward the anterior mid-margin and curves posteriorly sharply down to join the anterior ridge of the ala mid-ventrally. At the center this ridge is elevated laterally and deflected backward in very well-preserved specimens. Posterodorsally there is a high, bifid spinelike node, which projects over the dorsal margin. The posteroventral margin bears a strong, backwardly-pointing spine. Interior typical for the genus.

Dimensions.—HVH No. 10668 (left valve, holotype), L: 0.45; H: 0.25; HVH No. 10670 (right valve), L: 0.45; H: 0.20; HVH No. 10670 (left valve, very large specimen), L: 0.55; H: 0.29; W: 0.25 (all loc. NMB 16185).

Material.—Ten specimens.

Remarks.—*Paracytheridea hispida* Bold, 1946 (p. 87, pl. 9, fig. 10) from the Eocene of Bonaire is very similar in size and shape, but differs in having a lower projection of the anterior cardinal angle in the left valve, and a more bladelike extension of the subcentral tubercle.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Cercado and Gurabo formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Santiago): (Table 4).

Distribution.—Upper Miocene to Pliocene: Cuba, Dominican Republic.

Paracytheridea tschoppi Bold
Plate 11, figure 2

Paracytheridea tschoppi Bold, 1946, p. 85, pl. 16, figs. 6, 7; Bold, 1968, p. 76 (with synonymy), pl. 4, figs. 8a–d; Bold, 1975a, p. 150, pl. 16, figs. 3, 4; Teeter, 1975, p. 471, figs. 17c, 18a; Bold, 1978b, table 9; Bold, 1981, p. 22, table 15.

Diagnosis.—A species of *Paracytheridea* with high, four-pointed posterodorsal boss, and rounded, projecting anterior cardinal angle in the left valve.

Holotype.—GIRU D 13004.

Type locality.—Loc. T 1451, shore of Bahia de Nipe, west of Antilles, Oriente Province, Cuba.

Stratigraphic horizon.—Upper Nipe Formation, upper Miocene (= Júcaro Formation of Kozary, 1957, Jakus, 1983).

Dimensions.—HVH No. 10666 (right valve), L: 0.57; H: 0.25 (loc. NMB 16964).

Material.—More than 50 specimens.

Remarks.—*P. tschoppi* Bold of Benson and Coleman (1963) and Maddocks (1974) does not have the projecting anterior cardinal angle.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).

Distribution.—Lower Miocene to Recent: Caribbean, Gulf Coast.

Paracytheridea species A
Plate 11, figure 3

Paracytheridea sp. Bold, 1968, p. 76, pl. 4, figs. 7a, b.

Diagnosis.—A species of *Paracytheridea* with flat posterodorsal boss.

Reference material.—HVH No. 8351.

Reference locality.—Loc. H 15369, Río Guayabín, 6.5 km downstream from the Arroyo Yaguajai, Dominican Republic.

Stratigraphic horizon.—Cercado Formation (upper Miocene).

Dimensions.—HVH No. 10667 (right valve), L: 0.54; H: 0.25 (loc. NMB 16148).

Material.—Seven specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).

Paracytheridea species aff. **P. hispida** Bold

Paracytheridea sp. aff. *P. hispida* Bold. Bold, 1973a, table 1.
Paracytheridea sp. cf. *P. hispida* Bold. Bold, 1981, p. 84, pl. 3, fig. 14, table 11.

Reference material.—HVH No. 10066.

Reference locality.—Loc. K 921, Las Cahobas River, Haiti (Bold, 1981, text-fig. 9).

Stratigraphic horizon.—Madame Joie Formation (lower Miocene).

Material.—One broken left valve.

Occurrence.—Laguana amber site: (Table 5).

Distribution.—Lower to middle Miocene: Cuba, Hispaniola.

Paracytheridea species

Molts of a species of *Paracytheridea* that cannot be identified with certainty, occur in the Gurabo Formation of the Río Cana section (Table 1), and the Arroyo López part of the Río Yaque del Norte section (Table 4).

Subfamily **PEDICYTHERINAE** Sissingh, 1975

Genus **PEDICYTHERE** Eager, 1965

Pedicythere variabilis, new species
Plate 11, figures 12–17

Etymology of name.—(L.) *variabilis* = changeable [because of the variety of appearance, due in part to differences in preservation].

Diagnosis.—A species of *Pedicythere* with three to four flat, carinate or fringed, backward-curving spines.

Holotype.—HVH No. 10695 (right valve).

Paratypes.—HVH No. 10696 (left valve), HVH No. 10697 (right valve), HVH No. 10698 (right valve), HVH No. 10699 (left valve).

Type locality.—Loc. NMB 16039 (Río Gurabo).

Stratigraphic horizon.—Mao Formation.

Description.—Carapace small, elongate-triangular, highest at the anterior cardinal angle, close to the anterior extremity; caudal process deflected upward. Anterior margin regularly convex, bearing either a thin carina or up to six large, flattened spines; dorsal margin straight, forming a slight ridge, curving upward into the caudal process; ventral margin sinuous, almost parallel to the dorsal in the anterior half, swinging upward in a broad curve in the posterior end, becoming concave near the caudal process and bearing a strong, flat, curved spine. In the middle of the carapace and at about one-third of the height is a long, backward-curved, spinelike ala, the anterior edge of which is flattened to a thin carina, which may, however, be replaced by one large and several small, feathered spines; its posterior edge is also flattened to a carina, sometimes replaced by a parallel, flattened spine located between the ala and the posteroventral spine. In one specimen there is still another spine between this one and the ala. Surface smooth. At the anterior cardinal angle is a small, but well elevated eye tubercle. In one specimen the dorsal ridge exhibits several long, flat spines.

Marginal area broad in the anterior end, with long, sinuous pore canals. Hinge very weak, amphidont, with terminal, small teeth in the right valve and a very small anterior tooth in the left. Muscle scars form a somewhat oblique posterior row of four with a round frontal scar.

Dimensions.—HVH No. 10696 (left valve), L: 0.33; H: 0.17 (loc. NMB 15982); HVH No. 10699 (left valve), L: 0.31; H: 0.15 (loc. NMB 16030); HVH No. 10697 (right valve), L: 0.37; H: 0.19 (loc. NMB 15982); HVH No. 10698 (right valve), L: 0.40 (very long caudal process), H: 0.16 (loc. NMB 16097).

Material.—Seventeen specimens.

Remarks.—There is an enormous variation in the presence of spines, depending chiefly on the state of abrasion and preservation. As mentioned in the description, one specimen exhibits the feathered spines on the posterior edge of the ala as figured in *Pedicythere mirabilis* Sissingh, 1975 (p. 68, pl. 1, figs. 1, 2, pl. 2, figs. 1–3, pl. 3, figs. 1, 2, text-fig. 2). Another specimen has an extra spine behind the tip of the ala as in *Pedicythere phryne* Bonaduce, Ciampo, and Masoli, 1975 (p. 86, pl. 58, figs. 1–9, text-figs. 33, 34) [= *Pedicythere* sp. 1 of Sissingh, 1975 (pl. 3, fig. 3)] from the Adriatic Sea, or *P. neofluitans* Joy and Clark, 1977 (p. 138, pl. 1, figs. 18–20) from the Arctic. All these forms (in contrast to the present one) have the dorsal ridge pro-

jecting over the anterior end, forming an anterodorsal concavity, and lack eye tubercles. In this respect the present species is similar to *P. tessae* Eager, 1965 (p. 22, pl. 2, figs. 6–8), especially the less spinose specimens in the Dominican material, but differs by the lack of a continuation of the dorsal ridge parallel to the anterior margin. *Pedicythere* sp. 1 of Colalongo and Pasini, 1980 (p. 64, pl. 26, figs. 1, 2) appears to have the same arrangement of spines as the present species, but differs by its bossed dorsal margin. *P. polita* Colalongo and Pasini, 1980 (p. 108, pl. 24, figs. 7–10) is similar in outline and size, but lacks the upward deflection of the caudal process. *Pedicythere* sp. B of Cronin, 1983 (pl. 4, fig. I), which may be identical to *P. polita,* has been found in Rothwell's (1949) collections from the Gulf of Mexico (type 45, HVH No. 6359) at 1400 m depth. Cronin reports it from depths between 372 and 1034 m.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Yaque del Norte (Santiago): (Table 4).

Family **BYTHOCYTHERIDAE** Sars, 1926

Genus **BYTHOCERATINA** Hornibrook, 1952

Bythoceratina monoceros, new species
Plate 11, figure 18

Etymology of name.—(Gr.) *monos* = one + (Gr.) *ke* = horn.

Diagnosis.—A species of *Bythoceratina,* similar in shape to Cretaceous species of "*Monoceratina*".

Holotype.—HVH No. 10700 (right valve).

Paratype.—HVH No. 10701 (right valve).

Type locality.—Loc. NMB 15978 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace in side view subrectangular, height about half the length; anterior end blunt, posterior end a short dorsal caudal process. Anterior margin almost straight in dorsal half, convex in ventral part; dorsal margin almost straight, slightly sinuate near the cardinal angles; ventral margin generally parallel, slightly concave in front of the middle, sweeping upward to the posterior end in a broad curve that meets the dorsal margin at about a 70° angle. There is a deep, vertical, median sulcus and just posterior to its lower end (at about one-third of the height) a strong spine projects laterally. The middle portion of the carapace is strongly swollen, greatest width at the position of the spine, at about one-third of the length from the posterior extremity. Midway between the anterior cardinal angle and the median sulcus is an anterodorsal depression of roughly triangular shape. From the slightly elevated area between the two sulci a posterodorsal ridge defines the dorsal termination of the median sulcus, whereas a slightly more dorsally-positioned anterodorsal ridge forms the termination of the anterodorsal sulcus. Anteriorly, ventrally, and posteriorly, the carapace is strongly laterally-compressed, forming a sort of keel, which ends anteriorly against the oblique anteroventral extension of the swollen midportion. Above this extension the anterior margin is once again strongly compressed. The surface is covered with a network of fossae, which themselves are further subdivided. The largest fossae occur around the lateral spine, below which their longitudinal dividing ridges form short, projecting crests. The reticulation fades towards the compressed margins.

Marginal area broad anteriorly and posteroventrally. No pore canals or muscle scars could be seen. The hinge consists in the left valve of a narrow, faintly crenulate bar, which curves over open terminal sockets.

Dimensions.—HVH No. 10700 (right valve, holotype), L: 0.53; H: 0.29 (loc. NMB 15978); HVH No. 10701 (right valve), L: 0.48; H: 0.25 (loc. NMB 16030).

Material.—Five specimens.

Remarks.—Carapaces of this species are extremely fragile and several specimens were broken with repeated wetting, some more were destroyed in preparation of scanning electron micrographs. As mentioned in the diagnosis, this species is very similar in outline and ornamentation to some of the Cretaceous species of "*Monoceratina*", such as the *Monoceratina umbonata* (Williamson) group (*e.g.,* Alexander, 1934, pl. 8, fig. 9) or the *Cuneoceratina pedata* (Marsson) group. Incidentally, Coryell (1963, p. 1019), indicated that the name of Marsson's species is preoccupied by one of Geinitz (1843) [not seen, for reference see Coryell, 1963, p. 312], but this has been ignored by later workers except Benson and Tatro (1964). These groups and also *Bythoceratina mestayerae* Hornibrook, 1952 (pl. 16, figs. 257–259, 269) all differ by possessing raised anterior ridges instead of the compressed margin of the present species.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Pliocene: Dominican Republic; Recent: Gulf of Mexico, between depths of 60 and 1335 m, always rare. HVH No. 6337 (left valve) from Rothwell's (1949) collection of material from *Atlantis* cruise 1947, comes from 97 m water depth. Two other specimens, respectively from station 177 (70 m) and station 24 (60 m), have received HVH Nos. 10740 and 10741.

Bythoceratina species

Bythoceratina sp. Bold, 1968, table 9; Liebau, 1978, pl. 1, figs. G, H.

Diagnosis.—A species of *Bythoceratina* characterized by a strongly swollen ala, obscuring the posteroventral margin, a broad swelling anterior to the area

of adductor muscle attachment and a lesser one in the posterodorsal portion. Both ends laterally compressed.

Dimensions.—HVH No. 10799 (left valve), L: 0.57; H: 0.25 (loc. H 15212).

Material.—One specimen.

Remarks.—The specimen from loc. H 15212 (Bold, 1968, text-fig. 4) is identical to those figured by Liebau (1978) [lengths given as 0.53 mm and 0.49 mm], but slightly larger.

Occurrence.—Río Mao: (Table 3).

Distribution.—Upper Miocene: Dominican Republic; Recent: Jamaica (Runaway Bay).

Genus **PSEUDOCERATINA** Bold, 1965a

Pseudoceratina droogeri Bold

"*Monoceratina*" sp. Drooger and Kaasschieter, 1958, p. 91, pl. 4, figs. 12–14.

Pseudoceratina droogeri Bold, 1965a, p. 161, pl. 1, figs. 1–4, text-figs. 1, 2; Bold, 1966d, table 1; Bold, 1967b, p. 323; Bold, 1968, p. 78, pl. 6, fig. 2; Sissingh, 1975, pl. 2, fig. 4; Bold, 1978a, tables 1, 2; Bold, 1978b, table 9.

Holotype.—GIRU S 6349.

Type locality.—Station 1006 of Drooger and Kaasschieter, 100 km due east of the southeast tip of Trinidad, Orinoco shelf.

Stratigraphic horizon.—Recent.

Material.—Fifteen specimens.

Dimensions.—HVH No. 10702 (left valve), L: 0.52; H: 0.24 (loc. NMB 16964); HVH No. 10703 (right valve), L: 0.47; H: 0.22 (loc. NMB 16039).

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3).

Distribution.—Upper Miocene to Recent: Dominican Republic, Costa Rica; Recent: Orinoco shelf, Panama.

Genus **SCLEROCHILUS** Sars, 1866

Sclerochilus species
Plate 12, figure 4

Diagnosis.—A strongly-curved species of *Sclerochilus* with arched dorsal and concave ventral margin; posterior end broadly rounded below and laterally swollen.

Dimensions.—HVH No. 10681 (left valve), L: 0.46; H: 0.25 (loc. NMB 16978).

Material.—Four specimens.

Remarks.—This species is similar in appearance to specimens assigned to *Sclerochilus contortus* Norman (*e.g.*, by Cronin, 1981, p. 410, pl. 1, figs. 7, 8), but is more strongly bent in front of the middle and less elongate than Norman's species.

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo Formation (Table 2).

Family **PARADOXOSTOMIDAE** Müller, 1894

Genus **XIPHICHILUS** Brady, 1870b

Xiphichilus species
Plate 12, figure 7

Diagnosis.—A very elongate species of *Xiphichilus.*

Description.—Carapace in side view very elongate diamond-shaped, highest in the middle; anterior end low, very obliquely rounded with straight dorsal slope; dorsal margin convex, obtusely angled in the middle in the left valve; ventral margin very slightly convex, keeled; posterior end a submedian caudal process. Dorsal view lanceolate, widest in the middle. Surface smooth.

Marginal area broad, line of concrescence and inner margin close together and more or less parallel along the venter, diverging in both ends. Marginal pore canals widely spaced, except for a small cluster at the caudal process. Hinge very weak. Muscle scars a vertical row of four small scars, frontal scar not observed.

Dimensions.—HVH No. 10680 (left valve), L: 0.41; H: 0.18; W: 0.16; HVH No. 10679 (right valve), L: 0.43; H: 0.16 (loc. NMB 16145).

Material.—Thirteen specimens, valves very fragile, several broken in preparation for photography.

Remarks.—*Xiphichilus tenuissimoides* Swain, 1967 (p. 98, pl. 2, fig. 11, pl. 9, figs. 14a–e) is similar in general shape, but lacks the angulation at the greatest height in the left valve, and is larger. Specimens practically identical to Swain's species have been found on the Paria–Trinidad–Orinoco shelf. The Dominican species may be a direct ancestor.

Occurrence.—Río Gurabo: Cercado, Gurabo and Mao formations (Table 2).

Genus **PARADOXOSTOMA** Sars, 1866

Paradoxostoma species 1
Plate 12, figure 8

Diagnosis.—An elongate, lozenge-shaped, very fragile species of *Paradoxostoma.*

Dimensions.—HVH No. 10685 (right valve), L: 0.40; H: 0.16 (loc. NMB 16145).

Material.—Five specimens, very fragile, several specimens were lost during photography.

Remarks.—This species is considerably smaller than *P. artum* Bold, 1966c (p. 37, pl. 3, figs. 4a, b) and possesses a more drawn-out posterior end, but is otherwise quite similar.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3).

Paradoxostoma species 2
Plate 12, figure 6

Diagnosis.—An elongate-ovate species of *Paradoxostoma,* highest behind the middle, almost straight

ventral margin and a posterior end that is very narrowly rounded just above the middle, broadly convex below and concave above. Dorsal view lanceolate, widest in the middle.

Marginal area wide in anterior end; line of concrescence and inner margin close together and parallel to the venter, diverging in posterior and widely separated in anterior end. Marginal pore canals widely spaced in venter, somewhat more closely spaced in the anterior. Muscle scars: a row of four scars, no frontal scar observed.

Dimensions.—HVH No. 10689 (right valve), L: 0.52; H: 0.21 (loc. NMB 15990).

Material.—Nine specimens, several lost in preparation for photography.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Paradoxostoma species

Occurrence.—Single specimens of possibly more than one species occur in the Río Yaque del Norte section (López, Arroyo López): (Table 4).

Genus **PELLUCISTOMA** Coryell and Fields, 1937

Pellucistoma species aff. **P. magniventra** Edwards
Plate 12, figure 3

aff. *Pellucistoma magniventra* Edwards, 1944, p. 518, pl. 82, figs. 33–35.

Holotype.—USNM 559440.

Type locality.—Near Lumberton, North Carolina.

Stratigraphic horizon.—Duplin marl (Pliocene).

Remarks.—A few specimens have been found which are similar in outline to *P. magniventra,* except that they have an exaggerated bulge of the ventral margin, and are smaller.

Dimensions.—HVH No. 10676 (left valve), L: 0.39; H: 0.23 (loc. NMB 17011).

Material.—Three specimens.

Occurrence.—Río Cana: Gurabo Formation (Table 1).

Pellucistoma? **spurium** Bold?
Plate 12, figures 9–12

?*Pellucistoma spurium* Bold, 1963c, p. 406, pl. 10, figs. 5a, b, pl. 12, fig. 5.
Pellucistoma sp. Bold, 1967a, table 1.

Diagnosis.—A species of *Pellucistoma*?, elongate-ovate in shape with nearly parallel dorsal and ventral margins and a caudal process at median height.

Holotype.—USNM 684088.

Paratypes.—HVH No. 6887.

Type locality.—Loc. R 11862, Melajo River, Trinidad.

Stratigraphic horizon.—Melajo clay member of the Springvale Formation (Pliocene).

Dimensions.—HVH No. 10691 (left valve), L: 0.46; H: 0.21 (loc. NMB 17017).

Material.—Seventeen specimens.

Remarks.—Whereas the specimens in the Trinidad material are smooth to gently punctate, those in the Dominican material vary from slightly to rather heavily punctate, and there are a few carapaces of similar outline that show a reticulate pattern with perforations inside the fossae (Pl. 12, fig. 12). In addition all specimens show a well defined eye spot, placed rather far backwards and well below the hinge-line. Although the interior is identical to other species of *Pellucistoma,* the peculiar ornamentation makes the generic assignment uncertain and gives further significance to the name "*spurium*".

Occurrence.—Río Cana: Gurabo Formation (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene: Costa Rica; Pliocene: Trinidad, ?Dominican Republic.

Pellucistoma howei Coryell and Fields

Pellucistoma howei Coryell and Fields, 1937, p. 17, pl. 2, figs. 18a–c; Bold, 1967b, p. 314, pl. 1, fig. 17, pl. 2, fig. 5; Bold, 1968, table 9.

Holotype.—AMNH 24902.

Type locality.—Cativa, Panama.

Stratigraphic horizon.—Gatun Formation (upper Miocene).

Reference material.—HVH No. 8233 (Bold, 1967b, pl. 1, fig. 17).

Reference locality.—Loc. P 14, possibly identical to Coryell and Fields' locality.

Dimensions.—HVH No. 10793 (right valve), L: 0.46; H: 0.24 (loc. TU 1447).

Material.—One specimen.

Occurrence.—Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Upper Miocene: Hispaniola, Panama, Costa Rica.

Pellucistoma species

Pellucistoma sp. Bold, 1970b, p. 49, pl. 1, figs. 5a, b; Bold, 1972b, p. 436, pl. 1, fig. 12.
Pellucistoma sp. A. Bold, 1971a, table 2.

Diagnosis.—An elongate species of *Pellucistoma* with almost parallel dorsal and ventral margins, no conspicuous bulge of the posteroventer.

Reference material.—HVH No. 8711 (Bold, 1970b, pl. 1, figs. 5a, b).

Reference locality.—Loc. AG 7, Crocus Bay, Anguilla.

Stratigraphic horizon.—Anguilla Formation (upper lower to lower middle Miocene).

Dimensions.—HVH No. 10794 (right valve), L: 0.52; H: 0.25 (Bayaguana amber site).

Material.—Two specimens.

Occurrence.—Río Yaque del Norte (López): (Table 4). Bayaguana amber site: (Table 5).

Genus **MICROCYTHERE** Müller, 1894

Microcythere howei (Puri)
Plate 12, figure 5

Xestoleberis triangularis Puri, 1954, p. 298, pl. 16, figs. 1–4, text-figs. 14h, i [not *Xestoleberis triangularis* Weber, 1937, p. 40, figs. 5a, b].
?*Microcythere* cf. *inflexa* Müller. Puri, 1960, p. 119, pl. 5, figs. 13, 14; Teeter, 1973, table 1; Teeter, 1975, p. 482, fig. 20a.
Xestoleberis howei Puri, 1964, p. 787.
Microxestoleberis sp. Bold, 1964, table 2.
Microcythere howei (Puri). Bold, 1966c, p. 40, figs. 6a, b; Bold, 1972a, table 2.
Microcythere aff. *howei* (Puri). Bold, 1972a, table 3.
?*Microcythere* sp. 2. Howe and Bold, 1975, pl. 3, fig. 5.

Holotype.—HVH No. 3047.

Type locality.—One-fourth mile above Walsingham bridge in Ecofina Creek, Washington Co., Florida.

Stratigraphic horizon.—*Ecphora* facies of the Choctawhatchee Stage.

Dimensions.—HVH No. 10684 (left valve), L: 0.31; H: 0.15 (loc. NMB 16039).

Material.—Four specimens.

Occurrence.—Río Cana: Cercado Formation (Table 1). Río Gurabo: Cercado, Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene to Pliocene: Venezuela, Colombia, Dominican Republic, Florida; Pleistocene: Venezuela; Recent?: Florida, Orinoco shelf (confined to coarse sediment).

Genus **PARACYTHERE** Müller, 1894

Paracythere species
Plate 12, figures 1, 2

Paracythere sp. Bold, 1964, p. 9, table 2; Bold, 1966c, p. 37, pl. 1, figs. 6a, b, pl. 5, fig. 5.

Reference material.—HVH Nos. 7927, 10709.

Reference locality.—Station 1106 of Drooger and Kaasschieter (1958), Paria shelf.

Stratigraphic horizon.—Recent.

Diagnosis.—An ovoid-trapezoid species of *Paracythere* in which the dorsal margin of the left valve forms a slightly thickened ridge.

Description.—Carapace small, ovate-trapezoid in side view, highest in the middle; both ends obliquely rounded, more narrowly rounded below. Dorsal margin convex, slightly thickened to a ridge in the left valve; ventral margin almost straight, slightly sinuate. Shell very thin and transparent, surface smooth with distinct, regularly spaced, sieve-type normal pore canals.

Marginal area of moderate width with small vestibules both anteriorly and posteriorly, and widely spaced false radial pore canals. Hinge in the left valve consists of a crenulate bar with small, terminal, crenulate sockets. Selvage strongly incurved ventrally.

Dimensions.—HVH No. 10706 (left valve), L: 0.26; H: 0.18 (loc. 1106 of Drooger and Kaasschieter, 1958: Orinoco shelf, east of Trinidad).

Material.—One specimen.

Occurrence.—Río Gurabo: Gurabo Formation (Table 2).

Distribution.—Pliocene: Venezuela, Dominican Republic; Recent: Paria shelf (41–187 m).

Family **XESTOLEBERIDIDAE** Sars, 1928

Genus **XESTOLEBERIS** Sars, 1866

Xestoleberis duo, new species
Plate 13, figures 9, 10

Xestoleberis sp. 2. Bold, 1968, p. 78, pl. 6, figs. 8a–d; Bold, 1975a, p. 151, pl. 18, figs. 1–4.
Xestoleberis sp. Bold, 1981, table 15.

Etymology of name.—(L.) *duo* = two [because this species has twice received this number in open nomenclature].

Diagnosis.—A species of *Xestoleberis* of ovate shape, with sexual dimorphism easily visible only in dorsal view; female very broadly rounded behind, male more acuminate.

Holotype.—HVH No. 10720 (left valve, male).

Paratype.—HVH No. 10721 (left valve, female), HVH No. 10722 (carapace, female).

Type locality.—Loc. NMB 16145 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation.

Description.—Carapace ovate in side view, highest in the middle. Anterior end obliquely rounded, narrowly rounded below, anterodorsal slope gently convex up to the greatest height; dorsal margin convex, sloping gently down from the highest point; posterior margin steep, gently convex in dorsal part, broadly rounded ventrally; ventral margin almost straight, very slightly sinuate. Carapaces of both sexes are very similar in side view, but strongly differ in dorsal view: female, broadly pear-shaped, widest at two-thirds of the length from the anterior extremity, anterior end somewhat acuminate, posterior end well-rounded; male, spindle-shaped, widest at three-fifths of the length from the anterior end, both ends about equal, slightly acuminate. Surface smooth with well-defined normal pore canals. Interior typical of the genus.

Dimensions.—HVH No. 10722 (carapace, female), L: 0.48; H: 0.33; W: 0.35; HVH 10720 (left valve, male), L: 0.50; H: 0.33; W: 0.17 (loc. NMB 16145).

Material.—More than 150 specimens.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López, Santiago): (Table 4).

Distribution.—Upper Miocene and Pliocene: Cuba, Hispaniola; Recent: Trinidad–Paria shelf (73 m).

Xestoleberis antillea, new species
Plate 13, figures 1–8

Xestoleberis sp. A. Bold, 1946, p. 120, pl. 16, figs. 17a–d; Bold, 1973b, table 1.
Xestoleberis sp. 4. Bold, 1968, p. 79, pl. 1, figs. 6a, b, d (not fig. 6c).
Xestoleberis sp. Bold, 1969, pl. 2, fig. 3.
Xestoleberis sp. 1. Bold, 1975c, p. 151, pl. 16, figs. 13, 14, pl. 18, fig. 16.

Etymology of name.—After its widespread occurrence in the Greater Antilles.

Diagnosis.—An elongate, ovate, very tumid species of *Xestoleberis.*

Holotype.—HVH No. 10711 (left valve, male).

Paratypes.—HVH No. 10712 (right valve, male), HVH No. 10713 (right valve, female), HVH No. 10714 (right valve, female), HVH No. 10715 (right valve, female), HVH No. 10716 (left valve, female), HVH No. 10717 (left and right valves, female), HVH No. 10718 (left valve, female), HVH No. 10719 (carapace, male).

Type locality.—Loc. NMB 16145 (Río Gurabo).

Stratigraphic horizon.—Gurabo Formation.

Description.—Female: carapace pyriform in side view, highest just behind the middle. Anterior end obliquely rounded, narrowly rounded ventrally; dorsal margin arched; ventral margin strongly sinuate, concave in front of the middle; posterior margin broadly and slightly obliquely rounded, slightly more narrowly rounded subdorsally. Dorsal view elongate pyriform, widest just behind the middle, posterior end more broadly rounded than anterior.

Male: very similar to female, but lower; greatest height slightly more towards the posterior; posterior end less obliquely rounded. Dorsal view elongate spindle-shaped, widest behind the middle.

Interior typical for the genus; vestibule in anterior end; pore canals numerous, short. Row of four rather elongate adductor scars, irregularly-rounded scar in front, close to the vertical row of adductor scars.

Dimensions.—HVH No. 10713 (right valve, female), L: 0.36; H: 0.23; W: 0.12 (loc. NMB 17010); HVH No. 10717 (right valve, female), L: 0.36; H: 0.24; W: 0.12 (loc. NMB 17010); HVH No. 10712 (right valve, male), L: 0.35; H: 0.21; W: 0.09 (loc. NMB 16145); HVH No. 10711 (left valve, male, holotype), L: 0.35; H: 0.22; W: 0.09 (loc. NMB 16145).

Material.—About 150 specimens.

Remarks.—*Xestoleberis* sp. 2 of Bold, 1967a (p. 81, pl. 1, fig. 15 [= *X.* sp. of Bold, 1967b, p. 316, pl. 1, fig. 15]) of the Gatun Formation of Costa Rica and Panama is very similar, but has a slightly different rounding of the posterior end.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Yaque del Norte (Arroyo López): (Table 4).

Distribution.—Middle Miocene to Recent: Greater Antilles; Recent: Paria shelf.

Xestoleberis punctata Tressler?
Plate 13, figures 11–14

Xestoleberis margaritea Brady, 1868, p. 152; Baker and Hulings, 1966, p. 122, pl. 2, fig. 9 [not *Cytheridea margaritea* Brady, 1866, p. 370, pl. 58, figs. 6a–d].
?*Xestoleberis punctata* Tressler, 1949, p. 342, fig. 12; Puri, 1960, p. 122, pl. 5, figs. 9, 10; Teeter, 1975, p. 185, figs. 21o, 22e.
Xestoleberis margaritea Brady?. Bold, 1963c, p. 402, pl. 10, fig. 13.
Xestoleberis sp. aff. *X. margaritea* Brady. Bold, 1966d, p. 52, pl. 4, figs. 11a, b, pl. 5, fig. 3.
?*Xestoleberis rigbyi* Morales, 1966, p. 87, pl. 8, figs. 4a–d; Kontrovitz, 1978, p. 155, pl. 5, fig. 3.
Xestoleberis sp. 3. Bold, 1968, p. 79 (part), pl. 1, figs. 7a, c (not fig. 7b); Bold, 1969, p. 123, pl. 2, figs. 1a, b.

Diagnosis.—A species of *Xestoleberis* with high, almost regularly-rounded posterior end, and low, obliquely-rounded anterior end. Dorsal margin arched to convex, ventral margin sinuate.

Holotype.—USNM 88847.

Type locality.—Tortugas, Florida.

Stratigraphic horizon.—Recent, shallow water.

Dimensions.—HVH No. 10724 (carapace, female), L: 0.41; H: 0.29; W: 0.26 (loc. NMB 16039); HVH No. 10725 (left valve, male), L: 0.33; H: 0.22 (loc. NMB 16106).

Material.—About 30 specimens.

Remarks.—The species as interpreted here has a somewhat variable height of the anterior end. The figured specimens from the Dominican Republic have a relatively low anterior, whereas *Xestoleberis* sp. 3 of Bold, 1968 (pl. 1, fig. 7a) shows a slightly higher anterior. *X. rigbyi* also has a slightly higher anterior, but not as blunt as the original *X. punctata.* On the other hand specimens from the Paria shelf are slightly lower anteriorly than most specimens from the Dominican Republic, some of which are identical to any of the above mentioned species. However, the Dominican specimens are slightly smaller than the Recent ones from either the Gulf of Mexico, Belize, or the Paria shelf. The main distribution of all Recent material is between 40 and 100 m.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Distribution.—Upper Miocene and Pliocene: Do-

minican Republic, Trinidad, Venezuela; ?Recent: Gulf of Mexico, Belize, Paria–Orinoco shelf.

Xestoleberis species 1

Xestoleberis sp. Bold, 1963b, p. 402, pl. 10, figs. 14a, b.
Xestoleberis sp. 1. Bold, 1968, p. 78, pl. 6, figs. 9a–c.

Reference material.—HVH No. 8382.
Reference locality.—Loc. H 15372, Río Guayabín, Dominican Republic (Bold, 1968, text-fig. 2).
Stratigraphic horizon.—Gurabo Formation.
Dimensions.—HVH No. 10797 (left valve, juvenile), L: 0.34; H: 0.20 (loc. NMB 16108).
Material.—Four specimens, all juveniles.
Occurrence.—Río Gurabo: Mao Formation (Table 2). Río Mao: (Table 3).

Xestoleberis species 3

Xestoleberis sp. 3. Bold, 1968, p. 79 (part), pl. 1, fig. 7b (not figs. 7a, c).

Reference material.—HVH No. 8385.
Reference locality.—Loc. H 150093, on old Santiago–Puerto Plata road (Bold, 1968, text-fig. 6).
Stratigraphic horizon.—Mao Formation.
Dimensions.—HVH No. 10798 (right valve), L: 0.43; H: 0.26 (loc. NMB 16106).
Material.—Nine specimens.
Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Xestoleberis species B

Xestoleberis sp. B. Bold, 1966d, p. 52, pl. 3, fig. 13.

Reference material.—HVH No. 8290.
Reference locality.—Loc. P 16, Colón Harbor, Panama.
Stratigraphic horizon.—Recent.
Dimensions.—HVH No. 10796 (left valve), L: 0.38; H: 0.19 (loc. NMB 16147).
Material.—One specimen.
Occurrence.—Río Gurabo: Gurabo Formation (Table 2).
Distribution.—Recent: Panama.

Xestoleberis species E
Plate 12, figure 13

Dimensions.—HVH No. 10727 (left valve), L: 0.43; H: 0.18 (loc. NMB 16097).
Material.—Two specimens.
Occurrence.—Río Gurabo: Mao Formation (Table 2).

Xestoleberis species H
Plate 12, figure 14

Dimensions.—HVH No. 10728 (carapace), L: 0.48; H: 0.28 (loc. NMB 16180).
Material.—Four specimens.
Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Xestoleberis species

Several indeterminable species are lumped together under this heading.
Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1). Río Gurabo: Gurabo and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Baitoa, López, Arroyo López and Santiago): (Table 4).

Genus **UROLEBERIS** Triebel, 1958

Uroleberis torquata Bold
Plate 13, figure 16

Uroleberis torquata Bold, 1968, p. 81, pl. 6, fig. 4, pl. 10, fig. 2; Bold, 1975a, pp. 581, 582, table 4; Bold, 1975c, p. 152, table 4.

Diagnosis.—A species of *Uroleberis* with blunt ventral alae, and a sharp posterodorsal angulation.
Holotype.—HVH No. 8377.
Type locality.—Loc. H 15093, on old road from Santiago to Puerto Plata (Bold, 1968, text-fig. 6).
Stratigraphic horizon.—Mao Formation.
Dimensions.—HVH No. 10730 (left valve), L: 0.52; H: 0.29 (loc. NMB 16097).
Material.—Two specimens.
Occurrence.—Río Gurabo: Mao Formation (Table 2).
Distribution.—Pliocene: Cuba, Hispaniola.

Uroleberis triangula Bold
Plate 13, figures 17–19

Uroleberis triangula Bold, 1968, p. 80, pl. 6, figs. 5a–c, pl. 10, figs. 1a, b; Bold, 1971b, table 5; Bold, 1975c, p. 152, table 4.

Diagnosis.—A smooth, triangular species of *Uroleberis.*
Holotype.—HVH No. 8374.
Type locality.—Loc. H 15212, Rio Mao, Maury's station 1 = USGS loc. 8527 (Bold, 1968, text-fig. 4).
Stratigraphic horizon.—Gurabo Formation.
Dimensions.—HVH No. 10732 (carapace, female), L: 0.53; H: 0.34; W: 0.39 (loc. NMB 16182).
Material.—Ten specimens.
Occurrence.—Río Gurabo: Cercado, Gurabo, and Mao formations (Table 2). Río Mao: (Table 3). Río Yaque del Norte (Arroyo López): (Table 4).
Distribution.—Upper Miocene and Pliocene: Cuba, Dominican Republic, Jamaica.

Uroleberis species 1

Uroleberis sp. Bold, 1970b, p. 50, pl. 2, figs. 16a, b.

Reference material.—HVH No. 8725 (Bold, 1970b, pl. 2, figs. 16a, b).

Reference locality.—Loc. AG 3, Crocus Bay, Anguilla (Bold, 1970b, p. 36).

Stratigraphic horizon.—Anguilla Formation (upper lower to lower middle Miocene).

Dimensions.—HVH No. 10795 (carapace), L: 0.58; H: 0.33; W: 0.41 (Laguana amber site).

Material.—Fourteen specimens.

Occurrence.—Laguana amber site: (Table 5).

Distribution.—Upper lower to middle Miocene: Hispaniola, Anguilla, St. Martin.

Uroleberis species aff. **U.** sp. 1
Plate 1, figures 19, 20

Dimensions.—HVH No. 10735 (carapace), L: 0.46; H: 0.27; W: 0.28 (loc. NMB 16985).

Material.—Three specimens.

Remarks.—This species is similar to *Uroleberis* sp. 1, but less angular in dorsal view.

Occurrence.—Río Cana: Cercado and Gurabo formations (Table 1).

Uroleberis species

Scattered specimens of another species of *Uroleberis* occur in the Gurabo Formation. Most are probably molts and cannot be identified.

Occurrence.—Río Gurabo: Gurabo and Mao formations (Table 2).

Genus **MICROXESTOLEBERIS** Müller, 1894

Microxestoleberis species
Plate 13, figure 15

Diagnosis.—A species of *Microxestoleberis* with flattened venter and slightly produced posterior; dorsal margin convex, anterior end obliquely rounded, posterior end more steeply rounded.

Dimensions.—HVH No. 10729 (right valve), L: 0.33; H: 0.19 (loc. NMB 16108).

Material.—One specimen.

Remarks.—Clearly different from *Microxestoleberis*? sp. Bold, 1971b (p. 330, pl. 2, fig. 5, pl. 4, fig. 7) from the Pliocene of Jamaica.

Occurrence.—Río Gurabo: Mao Formation (Table 2). Río Mao: (Table 3).

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2. ***Propontocypris varaderoensis*** Lubimova and Sánchez 19
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3. ***Pontocypris*** ex gr. ***dreikanter*** (Coryell and Fields) 19
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4. ***Argilloecia vespa***, new species 20
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5. ***Argilloecia*** species 2 20
Carapace viewed from the left, HVH No. 10487, loc. NMB 16020, 85×.
6. ***Argilloecia*** species 3 21
Carapace viewed from the left, HVH No. 10488, loc. NMB 16020, 100×.
7. ***Argilloecia*** species cf. ***A. vespa***, new species 20
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8. ***Argilloecia*** species 21
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9, 10. ***Pontocypris*** species 19
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10. Carapace viewed from the left.

11, 12. ***Macrocypris*** species 1 21
11. Right valve, HVH No. 10493, loc. NMB 16039, 50×.
12. Left valve, HVH No. 10492, loc. NMB 16097, 50×.

13. ***Macrocypris*** species 2 22
Right valve, HVH No. 10494, loc. NMB 16030, 50×.

14. ***Macrocyprina*** species 22
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16, 17. ***Bairdoppilata oblongata*** (Bold) 23
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17. Left valve, HVH No. 10497, loc. NMB 16970, 45×.

18. ***Bairdia*** species aff. ***B. formosa*** Brady 23
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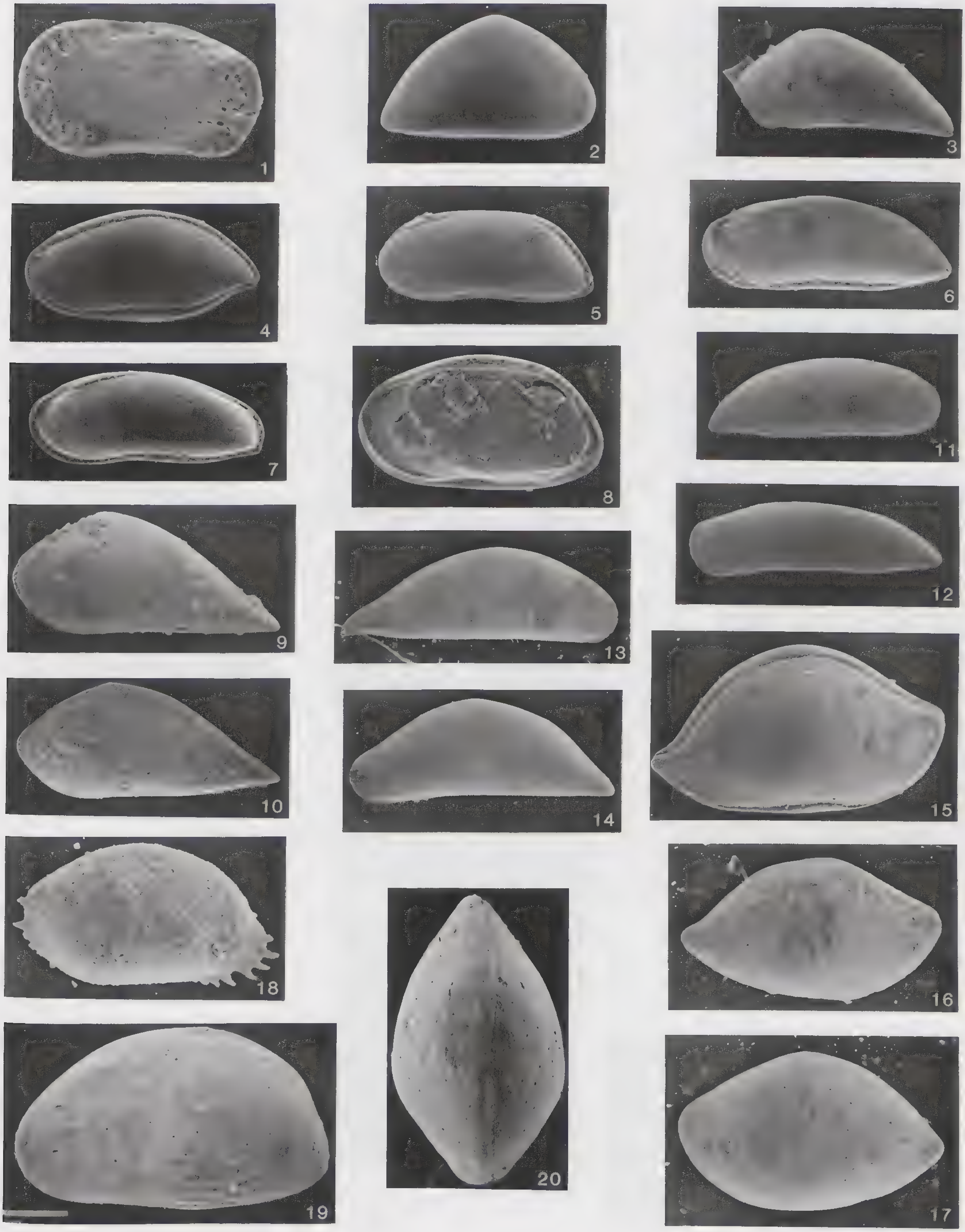
19, 20. ***Uroleberis*** species aff. ***U.*** species 1 70
19. Carapace viewed from the left, HVH No. 10734, loc. NMB 16985, 130×.
20. Carapace, dorsal view, HVH No. 10735, loc. NMB 16985, 120×.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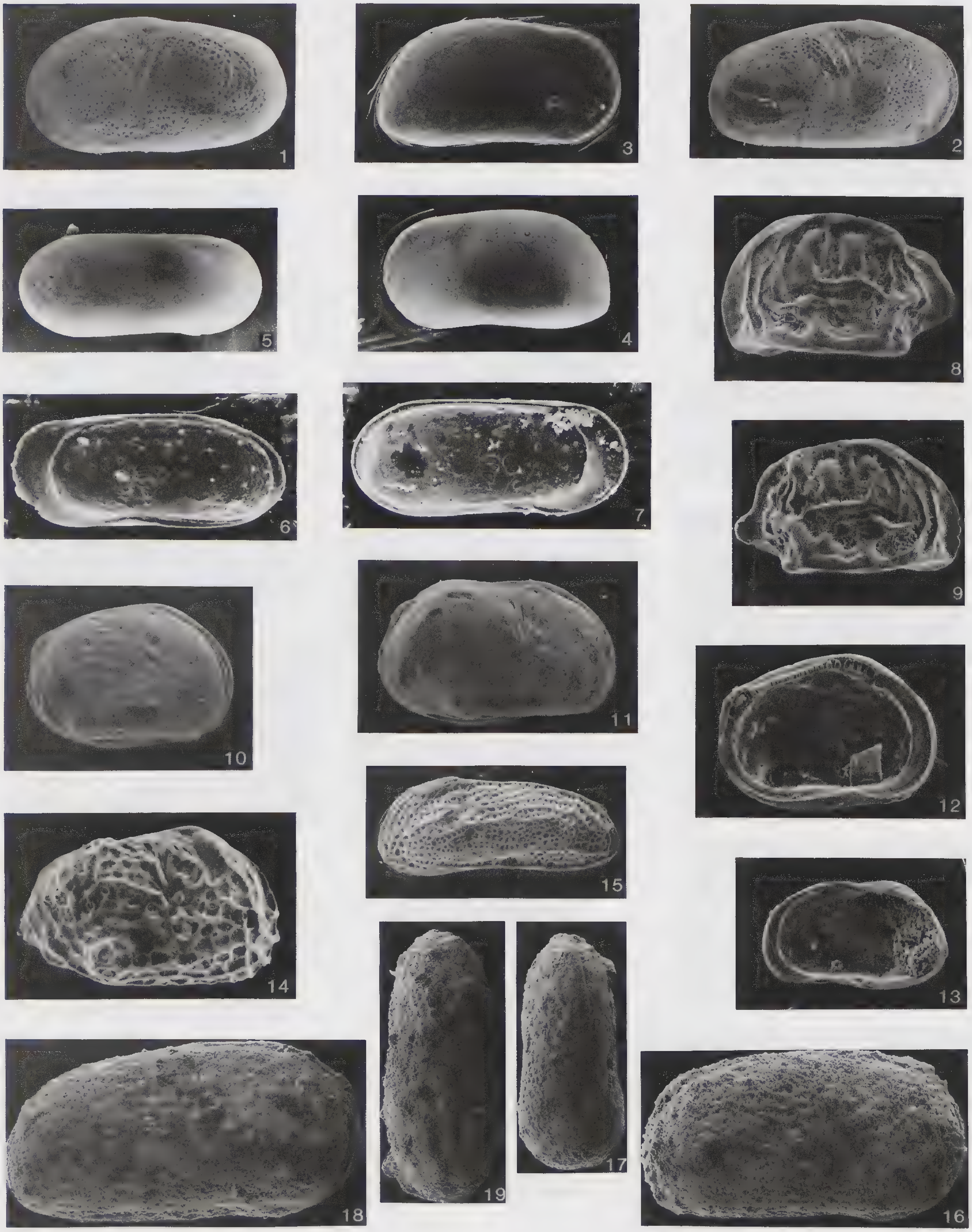
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3, 4. ***Parakrithe alta***, new species 26
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4. Left valve, HVH No. 10500 (holotype), loc. NMB 16108, 105×.

5–7. ***Pseudopsammocythere*** ex gr. ***vicksburgensis*** (Howe and Law) 27
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6. Right valve, interior view, HVH No. 10505, loc. NMB 16145, 115×.
7. Left valve, interior view, HVH No. 10506, loc. NMB 16145, 115×.

8, 9. ***Gangamocytheridea*? *plicata*** Bold 29
8. Left valve, HVH No. 10513, loc. NMB 16125, 115×.
9. Right valve, HVH No. 10513, loc. NMB 16125, 115×.

10–13. ***Perissocytheridea cahobensis*** Bold 28
10. Carapace viewed from the right, female, HVH No. 10511, loc. NMB 16205, 80×.
11. Carapace viewed from the right, male, HVH No. 10509, loc. NMB 16205, 80×.
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13. Right valve, interior view, male, HVH No. 10510, loc. NMB 16205, 65×.

14. ***Perissocytheridea pumila*** Bold 29
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15. ***Pumilocytheridea sandbergi*** Bold 29
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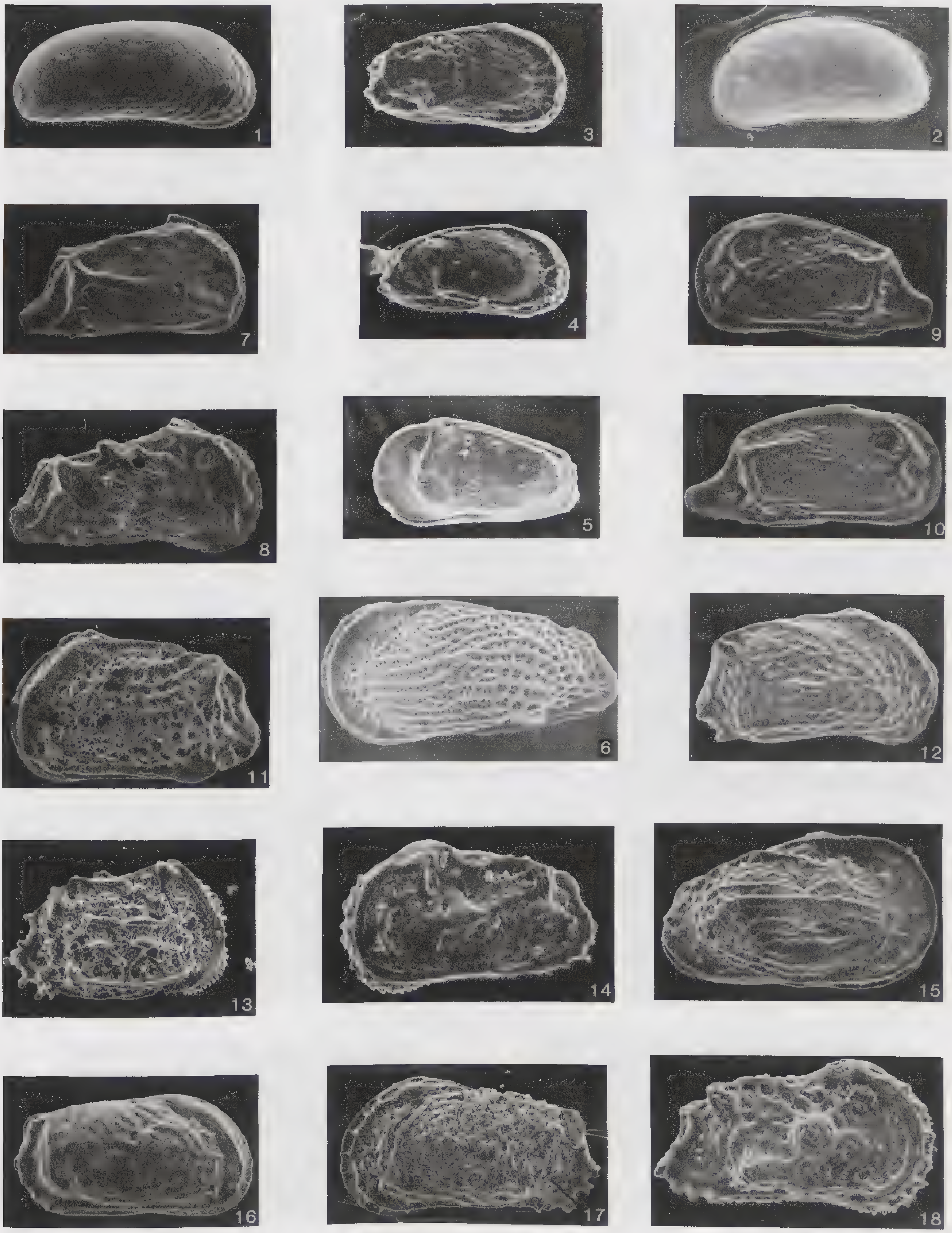

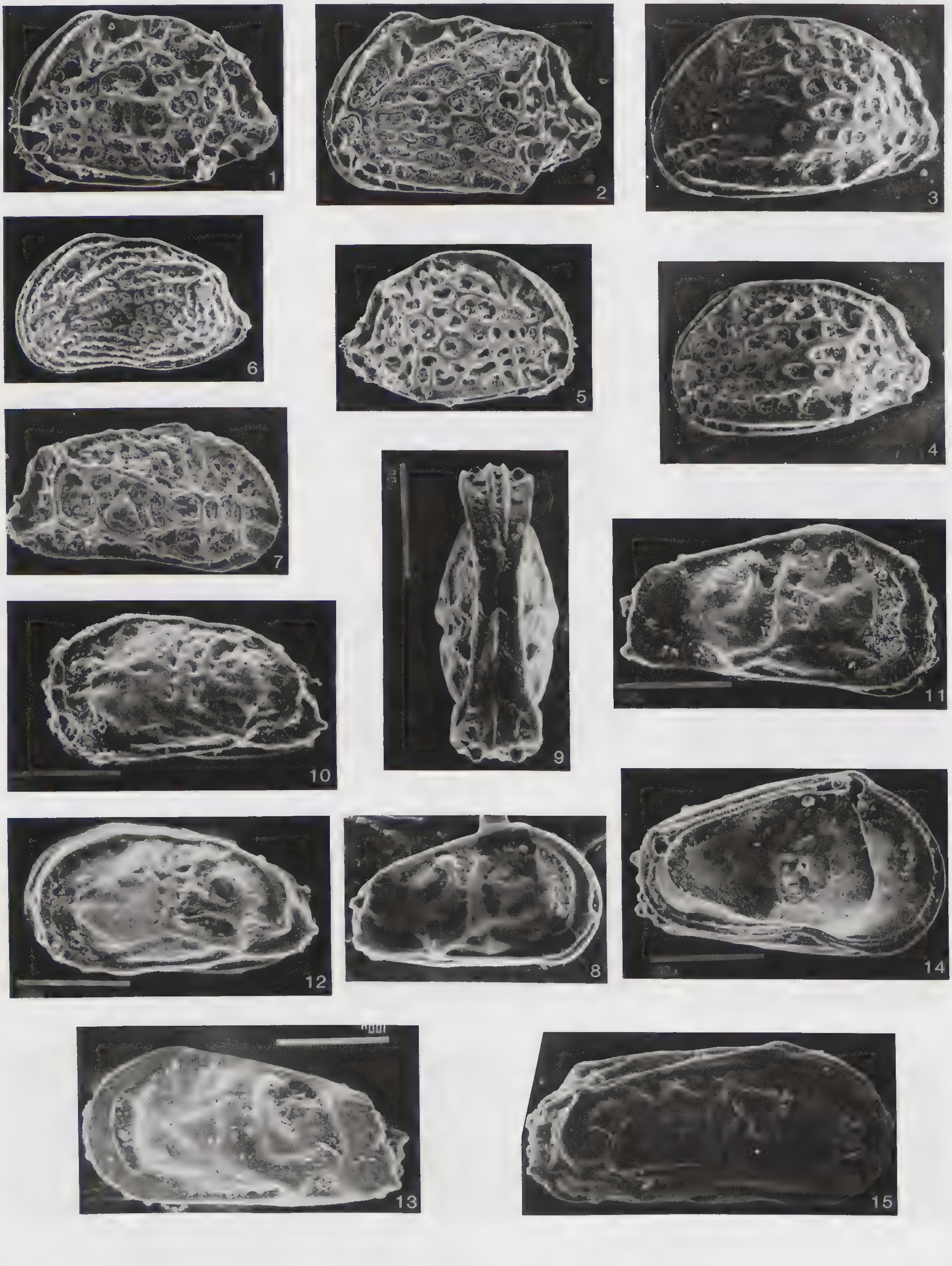
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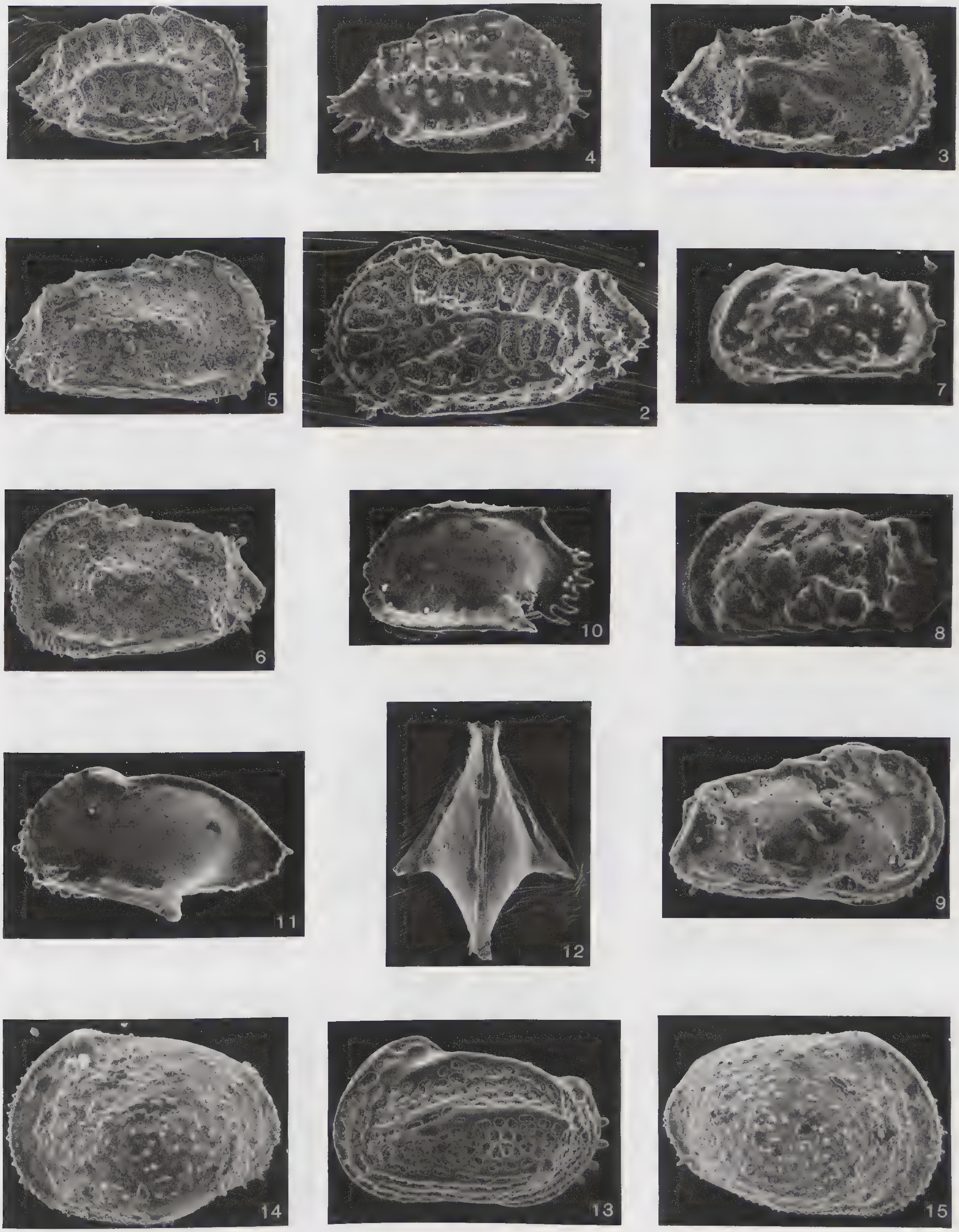
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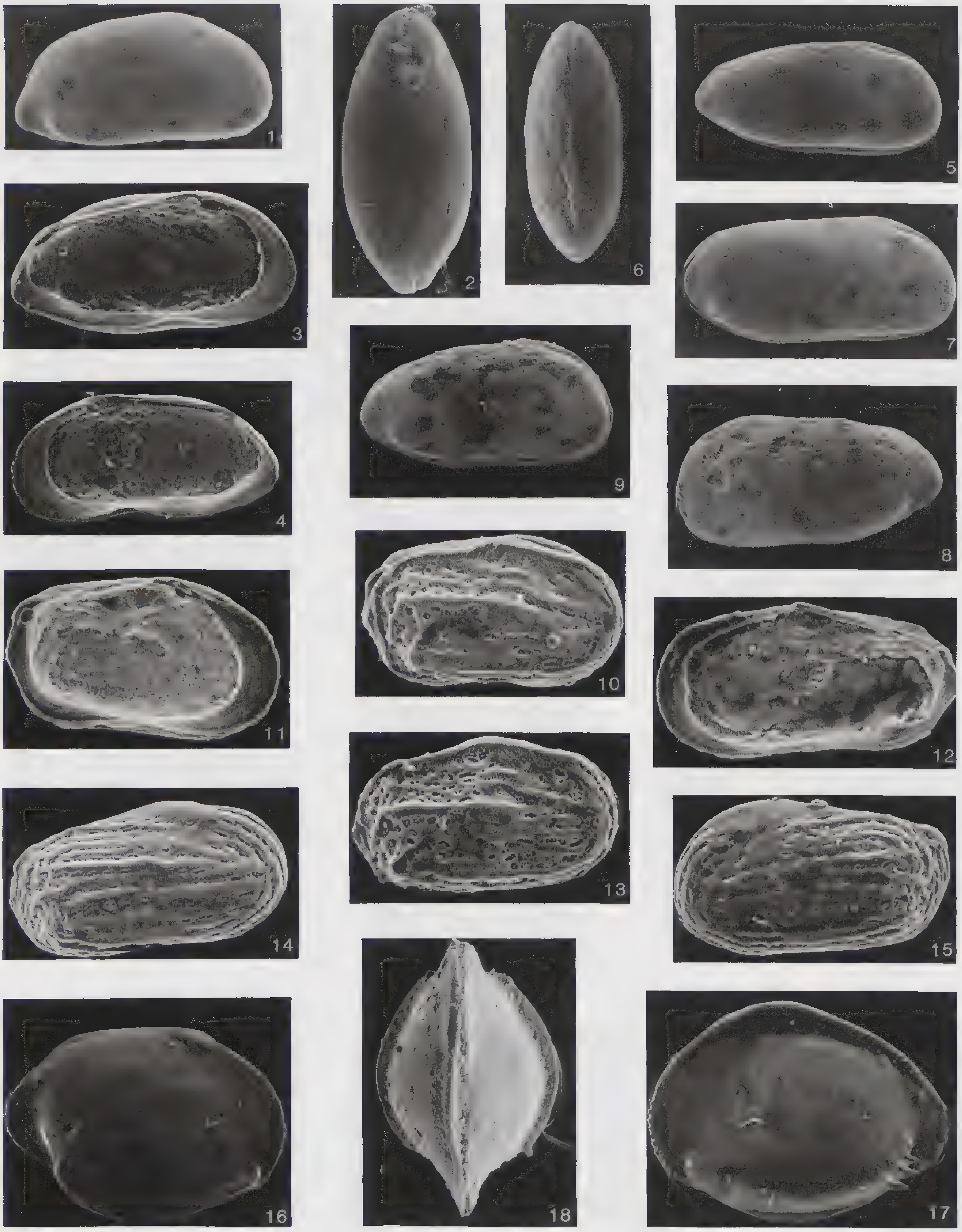
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EXPLANATION OF PLATE 6

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1–4. ***Proteoconcha*? *evai***, new species 44
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2. Carapace, dorsal view, HVH No. 10577 (holotype), loc. NMB 16135, 65×.
3. Left valve, interior view, HVH No. 10581, loc. NMB 17011, 65×.
4. Right valve, interior view, HVH No. 10580, loc. NMB 16135, 60×.

5, 6. ***Proteoconcha*? *elongata*** (Bold) 45
5. Carapace viewed from the right, HVH No. 10742 (Bold, 1964), loc. W 66, Guatemala, Rio Dulce Formation, 60×.
6. Carapace, dorsal view, HVH No. 10742, loc. W 66, Guatemala, Rio Dulce Formation, 60×.

7. ***Campylocythere*** species 45
Carapace viewed from the right, HVH No. 10582, loc. NMB 16995, 60×.

8, 9. ***Proteoconcha*? *elongata*** (Bold)? 45
8. Left valve, HVH No. 10743, loc. K 534, Haiti (Bold, 1981, p. 104), 60×.
9. Carapace viewed from the right, HVH No. 10744, loc. M 26, Comendador area, Dominican Republic, 60×.

10–13. ***Caribella geisteri***, new species 45
10. Carapace viewed from the right, HVH No. 10528 (holotype), loc. NMB 16964, 140×.
11. Left valve, interior view, female, HVH No. 10529, loc. NMB 16185, 140×.
12. Right valve, interior view, male, HVH No. 10530, loc. NMB 16097, 145×.
13. Right valve, female, HVH No. 10531, loc. NMB 16097, 140×.

14, 15. ***Caribella yoni*** (Puri) 46
14. Right valve, HVH No. 10533, loc. NMB 16978, 125×.
15. Left valve, HVH No. 10532, loc. NMB 16978, 125×.

16–18. ***Brachycythere*** species aff. ***B. russelli*** Howe and Lea 43
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17. Left valve, HVH No. 10575, loc. J 49 (Ecclesdown–Manchioneal section, Montpelier Group, Middle Miocene), Jamaica, 45×.
18. Carapace, dorsal view, HVH No. 10576, loc. J 160 (White River section, Buff Bay Formation, upper middle Miocene), Jamaica, 45×.

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	2. Right valve, HVH No. 10583, loc. NMB 16178, 95×.	
3, 4.	***Loxoconcha* (*Loxoconcha*) *spinolata*** Bold	47
	3. Left valve, HVH No. 10584, loc. NMB 16135, 100×.	
	4. Right valve, dorsal view, HVH No. 10585, loc. NMB 16135, 100×.	
5–7.	***Loxoconcha* (*Palmoconcha*) *banesensis*** Bold	48
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9, 10.	***Loxoconcha* (*Loxocorniculum*) *fischeri*** (Brady)	49
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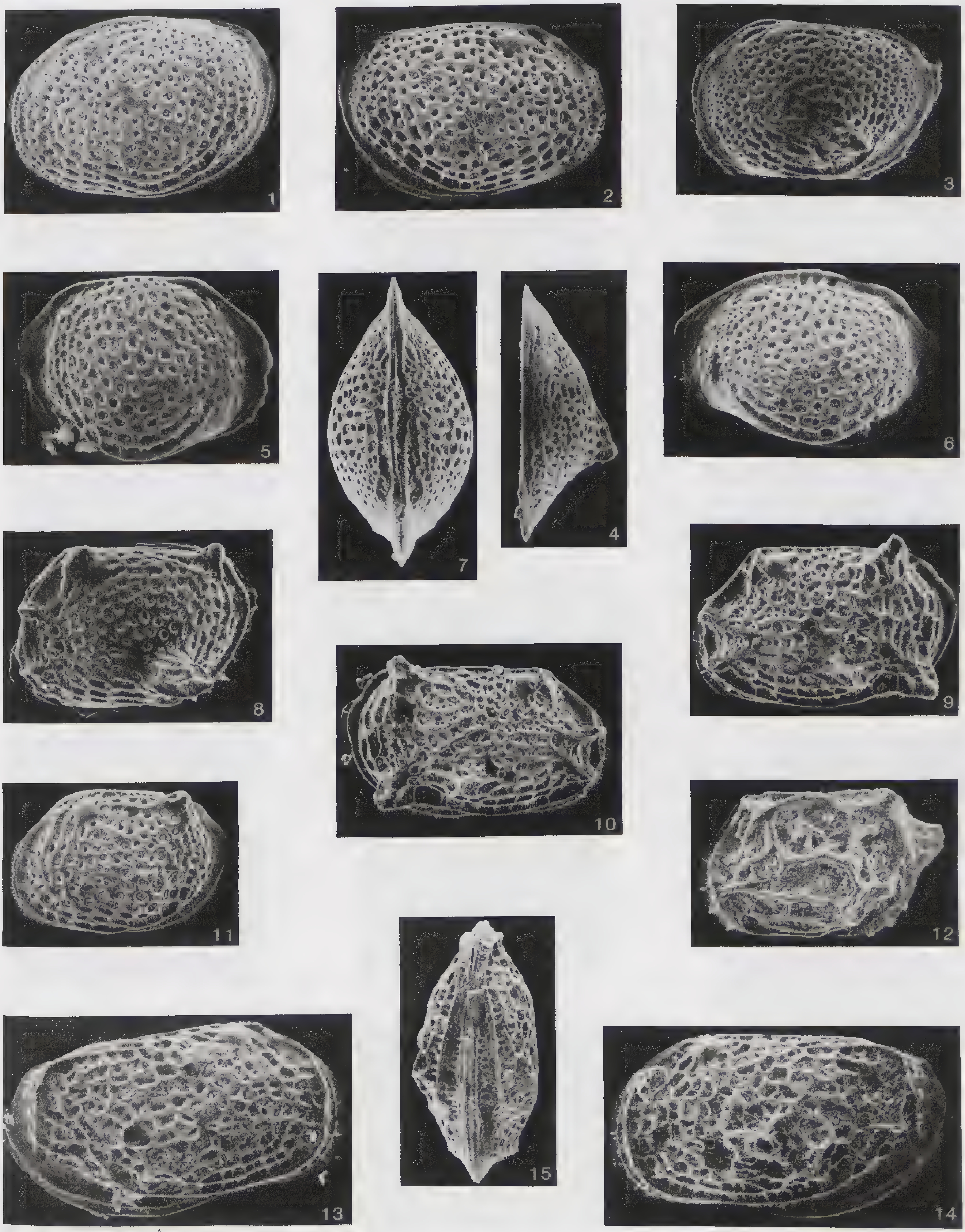
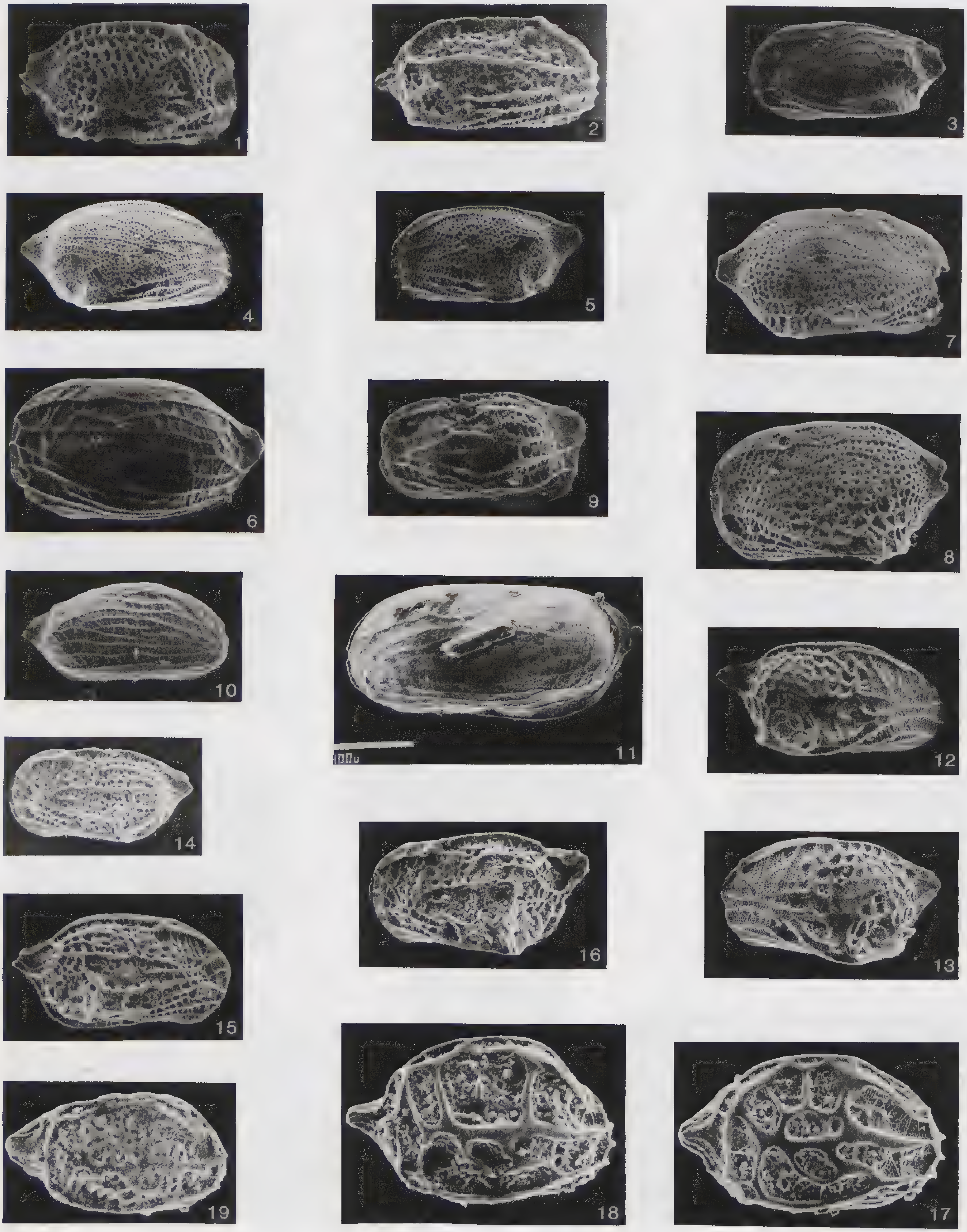
13–15.	***Loxoconcha* (*Loxoconcha*) *runa*** Bold	48
	13. Right valve, HVH No. 10737, loc. NMB 17189, 135×.	
	14. Left valve, HVH No. 10737, loc. NMB 17189, 135×.	
	15. Carapace, dorsal view, HVH No. 10737, loc. NMB 17189, 100×.	

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1. ***Cytherura cresera*** Bold 54
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4, 5. ***Cytherura*** species C 54
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   5. Left valve, HVH No. 10613, loc. NMB 15983, 115×.

6. ***Cytherura*** species D 54
   Left valve, HVH No. 10614, loc. NMB 16156, 120×.

7, 8. ***Cytherura*** species G 55
   7. Left valve, HVH No. 10615, loc. NMB 16148, 105×.
   8. Right valve, HVH No. 10616, loc. NMB 16148, 110×.

9. ***Cytherura*** species H 55
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10. ***Cytherura*** species I 55
   Right valve, HVH No. 10618, loc. NMB 17003, 140×.
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   Left valve, HVH No. 10748, loc. NMB 16093, 130×.

12, 13. ***Semicytherura*** species aff. ***S. arayaensis*** Bold 55
   12. Right valve, HVH No. 10619, loc. NMB 16054, 110×.
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14–16. ***Semicytherura*** species A 55
   14. Left valve, HVH No. 10622, loc. NMB 16993, 100×.
   15. Right valve, HVH No. 10623, loc. NMB 16148, 120×.
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17. ***Hemicytherura cranekeyensis*** Puri 56
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19. ***Hemicytherura*** species 56
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1. Left valve, HVH No. 10627, Station 1021 of Drooger and Kaasschieter (1958), Orinoco-Paria shelf, off Trinidad, 140×.
2. Right valve, HVH No. 10628, Station 1021 of Drooger and Kaasschieter (1958), Orinoco-Paria shelf, off Trinidad, 145×.
3. Right valve, HVH No. 10630, loc. NMB 16132, 190×.
4. Left valve, HVH No. 10629, loc. NMB 16964, 155×.

5. ***Eucytherura fithianae***, new species 57
Right valve, HVH No. 10631 (holotype), loc. NMB 17183, 150×.

6, 7. ***Eucytherura*** species A 57
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8. ***Eucytherura*** species B 57
Left valve, HVH No. 10635, loc. NMB 15983, 150×.

9, 10. ***Eucytherura*** species C 58
9. Left valve, HVH No. 10637, loc. NMB 16148, 180×.
10. Right valve, HVH No. 10636, loc. NMB 16148, 170×.

11. ***Eucytherura*** species D 58
Left valve, HVH No. 10638, loc. NMB 16125, 135×.

12, 13. ***Eucytherura*** species E 58
12. Right valve, HVH No. 10639, loc. NMB 16978, 175×.
13. Left valve, HVH No. 10639, loc. NMB 16978, 165×.

14. ***Eucytherura*** species G 58
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15. ***Kangarina depressa*** Bold 58
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16. ***Kangarina quellita*** Coryell and Fields 58
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17. "***Kangarina***" species aff. "***K.***" ***abyssicola*** (Müller) 59
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18. ***Saida***? ***kingmai*** (Bold) 59
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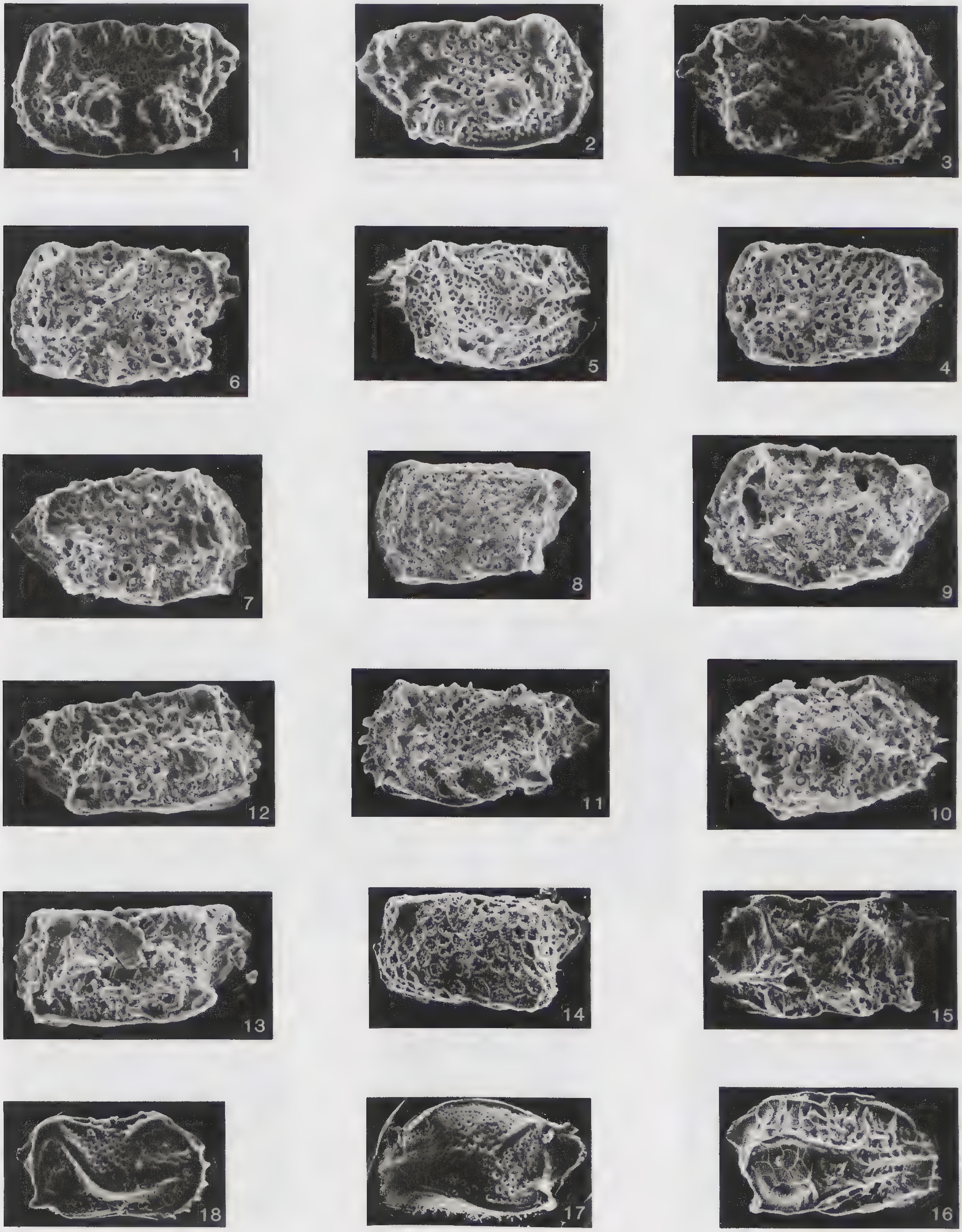
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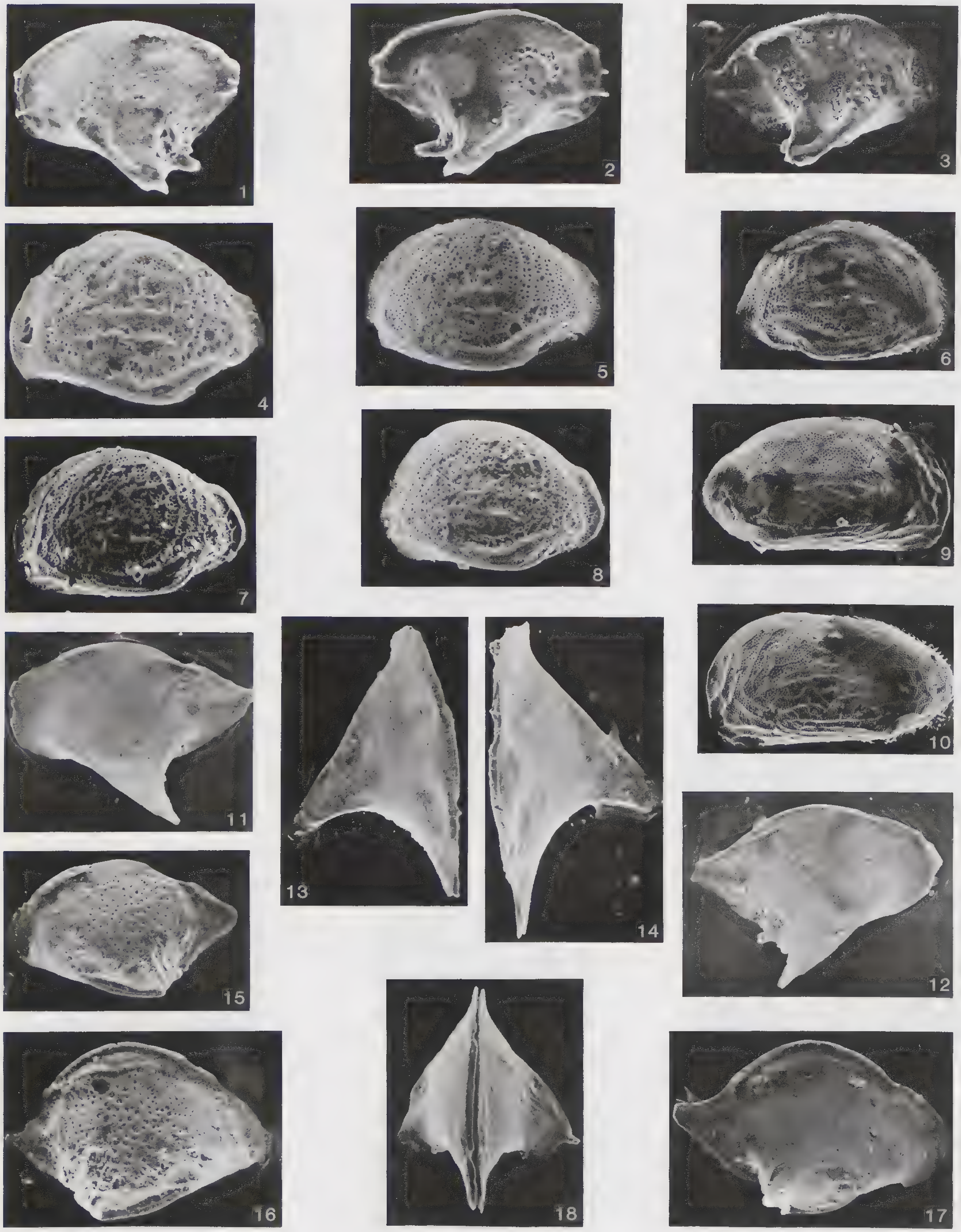
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1–3. ***Cytheropteron* (*Cytheropteron*) *guraboense***, new species 60
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2. Right valve, HVH No. 10646, loc. NMB 15978, 135×.
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4–10. ***Cytheropteron* (*Cytheropteron*) *dominicanum***, new species 59
4. Left valve, HVH No. 10649 (holotype), loc. NMB 16964, 180×.
5. Left valve, HVH No. 10650, loc. NMB 16964, 170×.
6. Right valve, HVH No. 10653, loc. NMB 16978, 160×.
7. Left valve, HVH No. 10652, loc. NMB 16978, 160×.
8. Left valve, HVH No. 10653, loc. NMB 16978, 160×.
9. Right valve, male?, HVH No. 10654, loc. NMB 16156, 180×.
10. Left valve, male?, HVH No. 10654, loc. NMB 16156, 180×.

11–14. ***Cytheropteron* (*Lobosocytheropteron*) *palton*** Bold 61
11. Left valve, HVH No. 10656, loc. NMB 15982, 90×.
12. Right valve, HVH No. 10655, loc. NMB 15982, 90×.
13. Left valve, dorsal view, HVH No. 10657, loc. NMB 15982, 95×.
14. Right valve, dorsal view, HVH No. 10657, loc. NMB 15982, 95×.

15–18. ***Cytheropteron* (*Aversovalva*) *bijuduvali***, new species 61
15. Left valve, HVH No. 10660, loc. NMB 15982, 95×.
16. Right valve, HVH No. 10659 (holotype), loc. NMB 15982, 115×.
17. Right valve, HVH No. 10662, loc. NMB 16097, 115×.
18. Carapace, dorsal view, HVH No. 10663, loc. NMB 16039, 95×.

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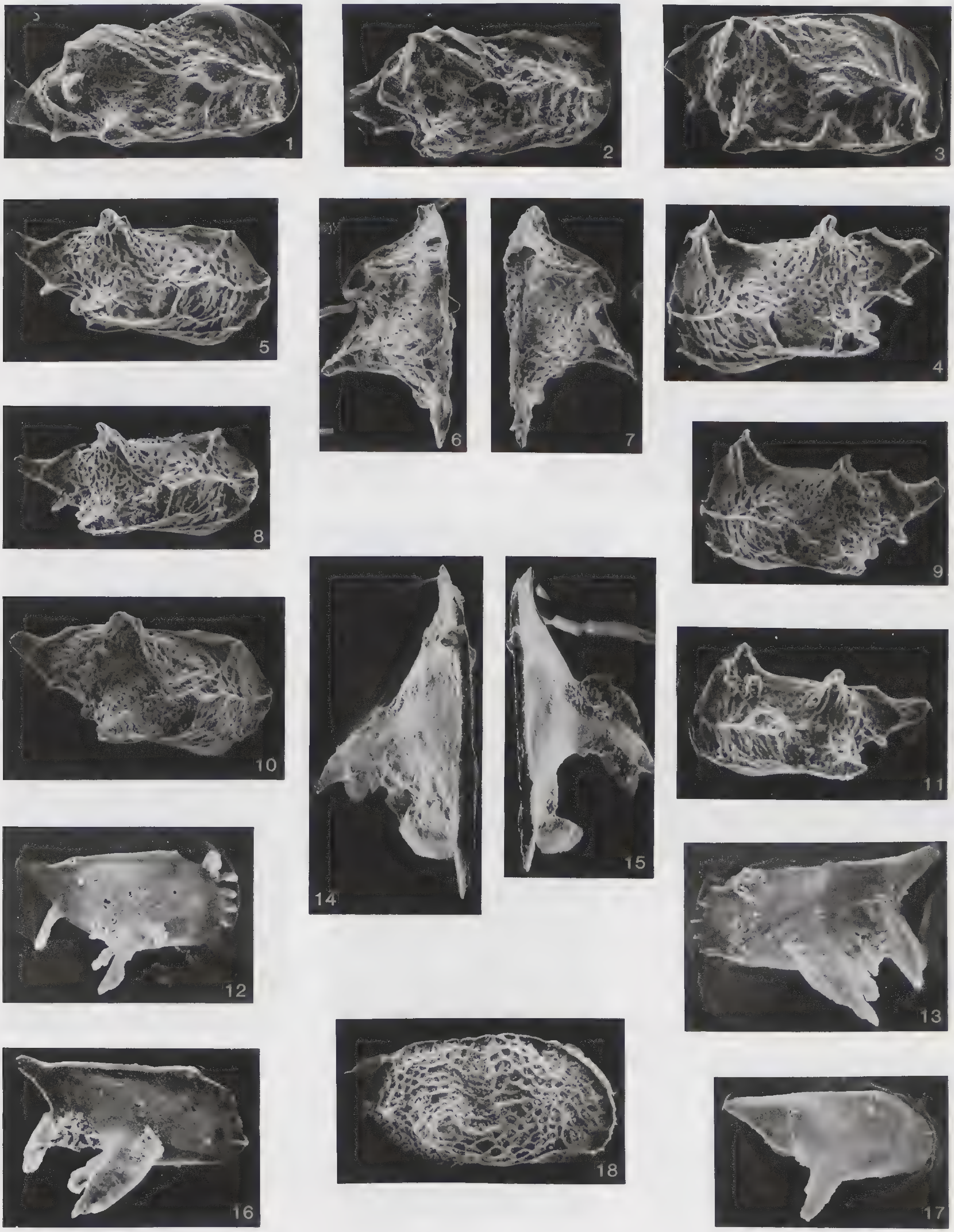
1. ***Paracytheridea altila*** Edwards 62
   Right valve, HVH No. 10665, loc. NMB 16103, 85×.
2. ***Paracytheridea tschoppi*** Bold 62
   Right valve, HVH No. 10666, loc. NMB 16964, 85×.
3. ***Paracytheridea*** species A 63
   Right valve, HVH No. 10667, loc. NMB 16148, 95×.

4–11. ***Paracytheridea calcitrapa***, new species 62
   4. Left valve, HVH No. 10668 (holotype), loc. NMB 16185, 115×.
   5. Right valve, HVH No. 10670, loc. NMB 16185, 110×.
   6. Left valve, dorsal view, HVH No. 10674, loc. NMB 16184, 100×.
   7. Right valve, dorsal view, HVH No. 10675, loc. NMB 16184, 100×.
   8. Right valve, HVH No. 10673, loc. NMB 16184, 100×.
   9. Left valve, HVH No. 10674, loc. NMB 16184, 100×.
   10. Right valve, HVH No. 10675, loc. NMB 16184, 110×.
   11. Left valve, HVH No. 10672, loc. NMB 16184, 100×.

12–17. ***Pedicythere variabilis***, new species 63
   12. Right valve, HVH No. 10695 (holotype), loc. NMB 16039, 135×.
   13. Left valve, HVH No. 10696, loc. NMB 15982, 145×.
   14. Left valve, dorsal view, HVH No. 10696, loc. NMB 15982, 190×.
   15. Right valve, dorsal view, HVH No. 10698, loc. NMB 16097, 145×.
   16. Right valve, HVH No. 10697, loc. NMB 15982, 120×.
   17. Right valve, HVH No. 10698, loc. NMB 16097, 100×.

18. ***Bythoceratina monoceros***, new species 64
   Right valve, HVH No. 10700 (holotype), loc. NMB 15978, 95×.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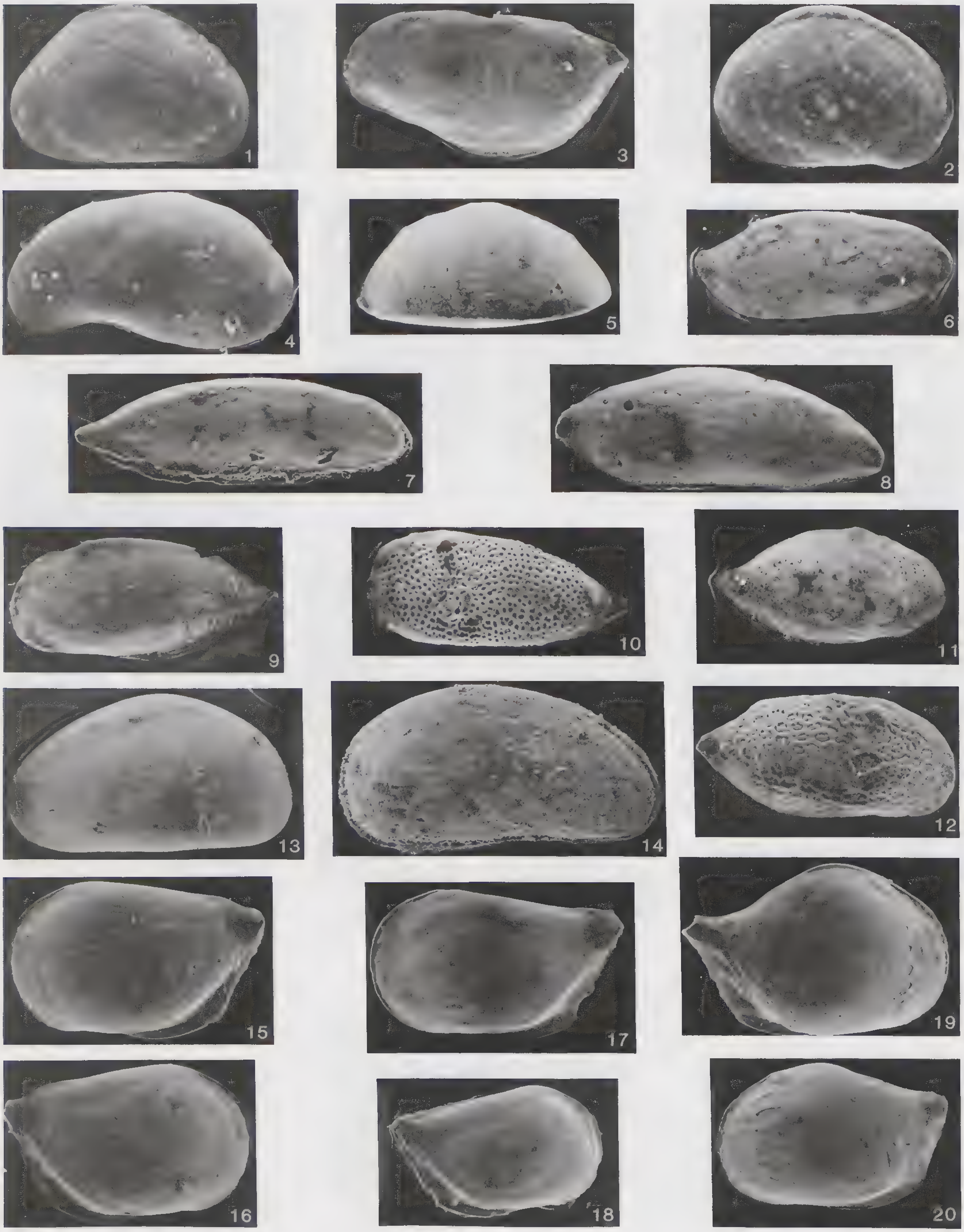
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1, 2. ***Paracythere*** species 67
1. Right valve, HVH No. 10708, loc. NMB 15983, 175×.
2. Carapace viewed from the right, HVH No. 10707, Station 1142 of Drooger and Kaasschieter, Orinoco shelf (1958), 170×.

3. ***Pellucistoma*** species aff. ***P. magniventra*** Edwards 66
Left valve, HVH No. 10676, loc. NMB 17011, 135×.

4. ***Sclerochilus*** species 65
Left valve, HVH No. 10681, loc. NMB 16978, 115×.

5. ***Microcythere howei*** (Puri) 67
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6. ***Paradoxostoma*** species 2 65
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7. ***Xiphichilus*** species 65
Carapace viewed from the right, HVH No. 10677, loc. NMB 15990, 145×.

8. ***Paradoxostoma*** species 1 65
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9–12. ***Pellucistoma***? ***spurium*** Bold? 66
9. Left valve, HVH No. 10692, loc. NMB 16039, 105×.
10. Left valve, HVH No. 10691, loc. NMB 17017, 105×.
11. Right valve (destroyed), loc. NMB 10639, 105×.
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13. ***Xestoleberis*** species E 69
Left valve, HVH No. 10727, loc. NMB 16097, 125×.

14. ***Xestoleberis*** species H 69
Carapace viewed from the right, HVH No. 10728, loc. NMB 16180, 125×.

15,16. ***Phlyctocythere stricta***, new species 52
15. Left valve, HVH No. 10594 (holotype), loc. NMB 17183, 100×.
16. Right valve, HVH No. 10595, loc. NMB 17183, 100×.

17, 18. ***Phlyctocythere recta***, new species 53
17. Left valve, HVH No. 10596 (holotype), loc. NMB 17011, 110×.
18. Right valve, HVH No. 10597, loc. NMB 17011, 95×

19,20. ***Phlyctocythere curva***, new species 52
19. Right valve, HVH No. 10600 (holotype), loc. NMB 16156, 115×.
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	3. Left valve, dorsal view, female, HVH No. 10717, loc. NMB 17010, 120×.	
	4. Right valve, dorsal view, female, HVH No. 10717, loc. NMB 17010, 120×.	
	5. Left valve, male, HVH No. 10711 (holotype), loc. NMB 16145, 110×.	
	6. Right valve, male, HVH No. 10712, loc. NMB 16145, 100×.	
	7. Carapace, dorsal view, male, HVH No. 10719, loc. NMB 10710, 145×.	
	8. Right valve, interior view, female, HVH No. 10715, loc. NMB 10710, 120×.	
9, 10.	***Xestoleberis duo***, new species	67
	9. Left valve, male (holotype), HVH No. 10720, loc. NMB 16145, 85×.	
	10. Carapace, dorsal view, female, HVH No. 10722, loc. NMB 16145, 90×.	
11–14.	***Xestoleberis punctata*** Tressler?	68
	11. Left valve, female, HVH No. 10723, loc. NMB 16030, 105×.	
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15.	***Microxestoleberis*** species	70
	Right valve, HVH No. 10729, loc. NMB 16108, 150×.	
16.	***Uroleberis torquata*** Bold	69
	Left valve, HVH No. 10730, loc. NMB 16097, 115×.	
17–19.	***Uroleberis triangula*** Bold	69
	17. Right valve, male, HVH No. 10731, loc. NMB 16097, 105×.	
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	19. Carapace, dorsal view, female, HVH No. 10733, loc. NMB 16182, 115×.	

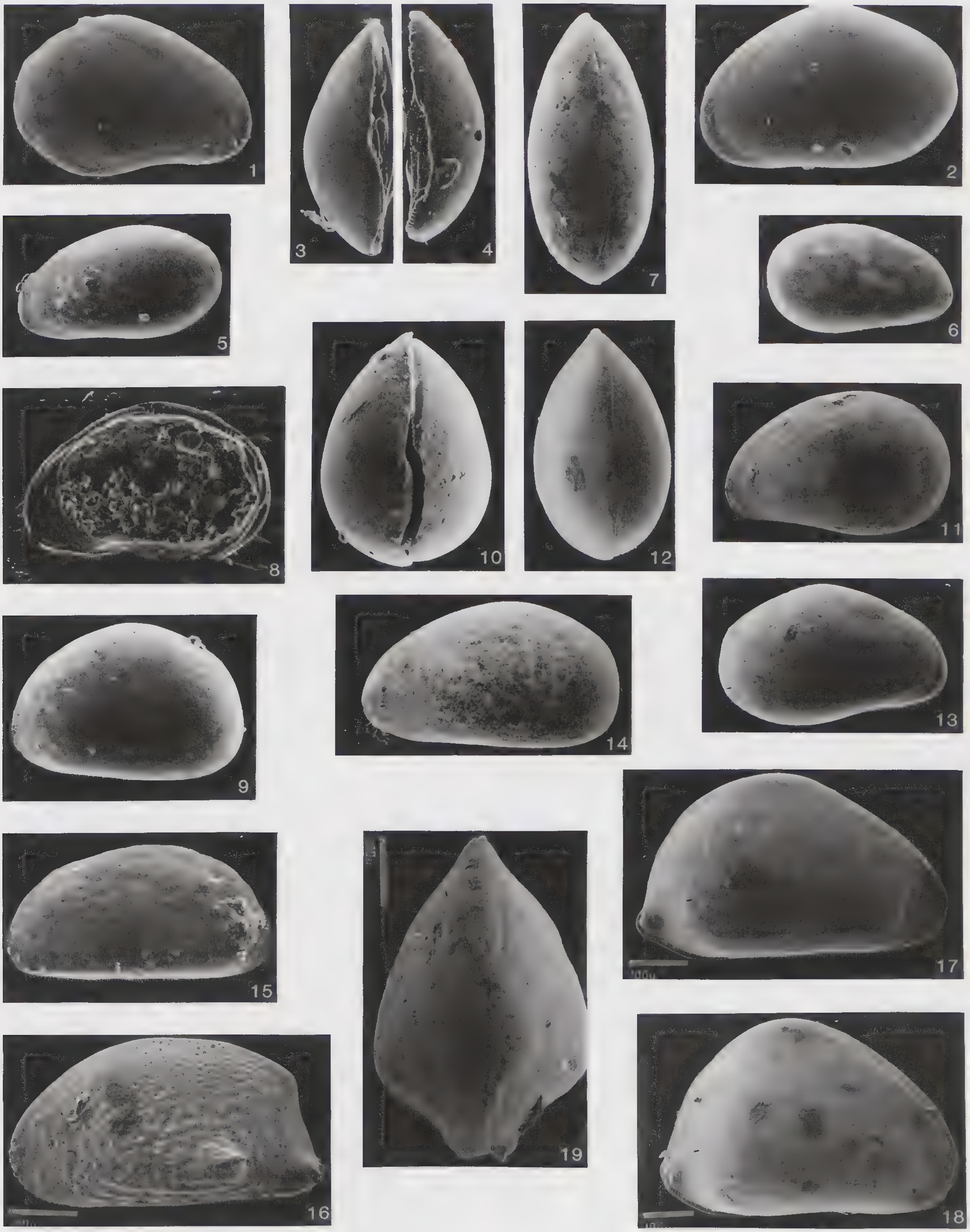
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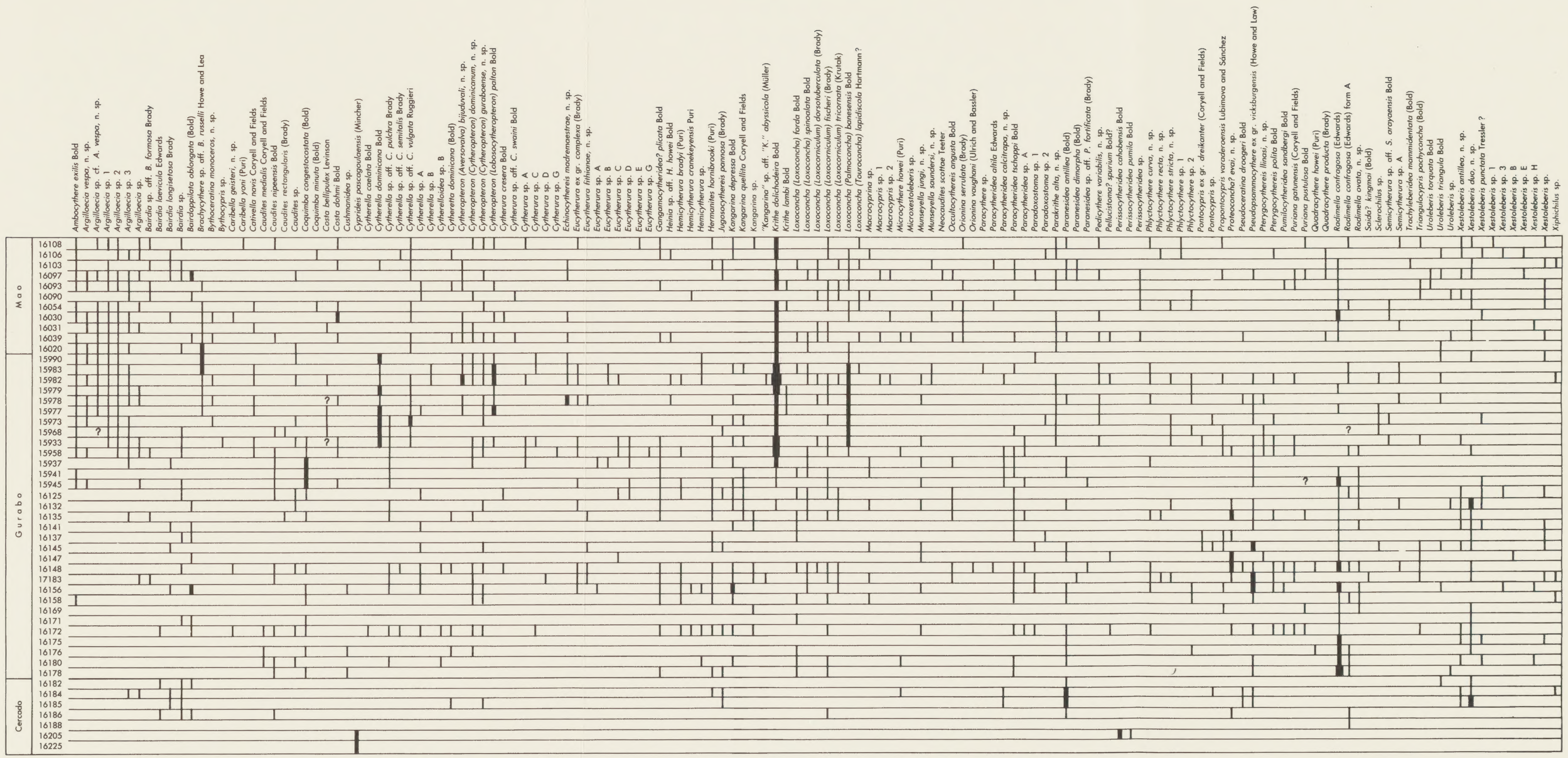
Table 2.—Distribution of Ostracoda in samples from the Río Gurabo section. Narrowest line = less than 10 specimens; medium width line = from 10 to 20 specimens; widest line = more than 20 specimens.



PREPARATION OF MANUSCRIPTS

Bulletins of American Paleontology usually comprises two or more separate monographs in two volumes each year. This series is a publication outlet for significant longer paleontological monographs for which high quality photographic illustrations and the large quarto format are a requisite.

Manuscripts submitted for publication in this monograph series must be typewritten, and double-spaced *throughout* (including direct quotations and references). All manuscripts should contain a table of contents, lists of text-figures and (or) tables, and a short, informative abstract that includes names of all new taxa. Format should follow that of recent numbers in the series. All measurements must be stated in the metric system, alone or in addition to the English system equivalent. The maximum dimensions for photographic plates are 178 mm × 229 mm (7″ × 9″; outlined on this page). Single-page text-figures should be drafted for reproduction as single column (82 mm; 3¼″) or full page (178 mm; 7″) width, but arrangements can be made to publish text-figures that must be larger. Any lettering in illustrations should follow the recommendations of Collinson (1962).

Authors must provide three (3) copies of the text and accompanying illustrative material. The text and line-drawings may be reproduced xerographically, but glossy prints at publication scale must be supplied for all half-tone illustrations and photographic plates. These prints should be identified clearly on the back.

All dated text-citations must be referenced. Additional references may be listed separately if their importance can be demonstrated by a short general comment, or individual annotations. Referenced publication titles must be spelled out in their entirety. Citations of illustrations within the monograph bear initial capitals (*e.g.,* Plate, Text-figure), but citations of illustrations in other articles appear in lower-case letters (*e.g.,* plate, text-figure).

Original plate photomounts should have oversize cardboard backing and strong tracing paper overlays. These photomounts should be retained by the author until the manuscript has been formally accepted for publication. Explanations of text-figures should be interleaved on separate numbered pages within the text, and the approximate position of the text-figure in the text should be indicated. Explanations of plates follow the Bibliography.

Authors are requested to enclose $10 with each manuscript submitted, to cover costs of postage during the review process.

Collinson, J.
1962. *Size of lettering for text-figures.* Journal of Paleontology, vol. 36, p. 1402.

Gilbert Dennison Harris
(1864 - 1952)

Founder of the *Bulletins of American Paleontology* (1895)

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